Compress

PERMANENT FILE
IR
LITERATURE
Return this copy to
Advertising Division
Ingersoll-Rand
Phillipsburg, New Jersey
File
X-1850 IR 2M 10-54

AUGUST 1952

STEEL PICKEREL BREAKING WATER

U. S. submarine surfacing at angle of 48 degrees off Hawaiian Islands

OFFICIAL PHOTOGRAPH, U. S. NAVY

VOLUME 57 • NUMBER 8

NEW YORK • LONDON

PROTECT AGAINST RUST CARBON WATER **IN COMPRESSORS**

. . . use the recommended Texaco air compressor oil

Rust, carbon and water are common hazards in air compressor operation. No one oil can efficiently or economically handle all of them. So Texaco has *a complete line* of air compressor oils to enable you to keep your compressors at peak performance regardless of operating conditions. For example —

WHEN SEVERE CONDITIONS are causing heavy deposits on valves, your Texaco Lubrication Engineer will recommend a Texaco *heavy-duty* air compressor oil to assure cleaner and more efficient operation.

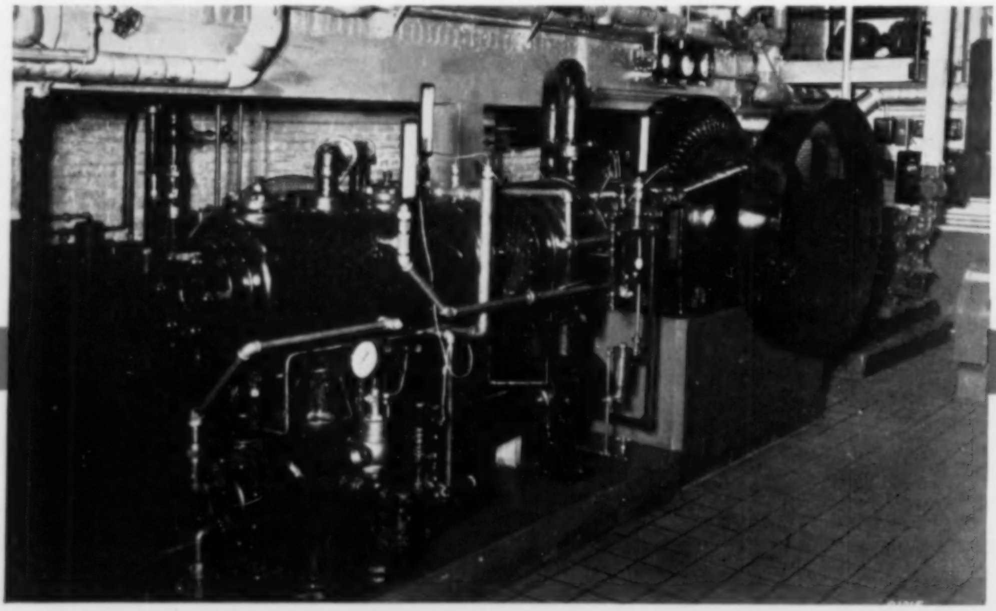
WHEN YOU'RE GETTING RUST in cylinders, coolers, lines and receivers, a Texaco *rust-inhibited* oil will be recommended to protect your equipment, whether running or idle.

WHEN EXCESS WEAR results from "wet cylinder" conditions, a Texaco *compounded* air compressor oil will stop it.

WHEN CONDITIONS ARE "NORMAL" a Texaco *straight mineral* air compressor oil will assure clean, efficient operation.

Let a Texaco Lubrication Engineer give you more detailed information. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write:

The Texas Company, 135 East 42nd Street, New York 17, N. Y.



TEXACO Air Compressor Oils

FOR ALL OPERATING CONDITIONS

Faithfully yours for Fifty Years

PIPE LINE FILTER
STAYNEW FILTERS
CORPORATION

Staynew Pipe Line Filters *help* *Taylor Instrument Companies* maintain High Quality, Accuracy...

One of a battery of Staynew Pipe Line Filters keeping impurities out of process compressed air at the Taylor Instrument Companies, Rochester, N.Y.

Pictured is part of an assembly line at the Taylor Instrument Companies where highly skilled technicians use compressed air to form the bulbs of precision fever and industrial thermometers. Impurities, no matter how minute, are kept from entering the .002″ bore to maintain high quality control. That's why the Staynew Model CPH-03 Pipe Line Filter is standard equipment at every bench.

Staynew's basic design first eliminates larger particles mechanically. Then, finer air-borne material is removed by the radial fin filter insert. This double action principle reduces the load on the insert making frequent cleanings unnecessary.

There can be no compromise with quality. Millions of thermometers will pass through the Taylor production lines this year where *Accuracy First* is the watchword. Wherever used, Staynew Filters give day in and day out dependable service with low maintenance cost.

Send for Pipe Line Filter Bulletin B-1A

Representatives in Principal Cities

DOLLINGER
REG
PROTECTOMOTOR
U.S. PAT OFF
STAYNEW FILTERS

DOLLINGER
CORPORATION
7 Centre Pk., Rochester 3, N. Y.

ALL TYPES OF FILTERS FOR EVERY INDUSTRIAL NEED

IN CANADA: Toronto - McCarthy & Robinson, Ltd.
Montreal - Engineering Equipment Co., Ltd.
Vancouver - P. D. McLaren & Sons, Ltd.
Winnipeg - Mumford-Medland, Ltd.

DON'T BE SATISFIED WITH HALF-WAY MEASURES...

insist on **Walseal**® products and be certain

— the FACTORY INSERTED Ring insures FULL PENETRATION of the Silver Alloy . . . a perfect joint

Today, contractors . . . builders . . . architects are using brazed connections, in ever increasing numbers on their brass and copper pipe runs. However, they must be certain that the correct brazing alloy is used; that the joint has penetration of alloy up the shoulder of the fitting.

That's why more and more are turning to Silbraz® joints made with Walseal valves, fittings and flanges which assure the proper amount of alloy with no waste. They know that the finished joint not only will withstand hydrostatic pressure, but it will also withstand terrific impact and vibration — in fact, no correctly made Silbraz joint has ever been known to creep or pull apart under any pressure, shock, vibration or temperature which the pipe itself can withstand.

Furthermore, it is a relatively simple operation to make a Silbraz joint — no heavy scaffolding need be erected . . . just cut the pipe, flux, assemble, then braze, following the technique recommended by the Walworth Company. A silver brazing alloy — FACTORY INSERTED — in each port flows out when heated with the oxyacetylene torch, making a joint that is stronger than the pipe itself . . . a one-hand operation, with the mechanic out of the path of the deflected heat — at all times.

For full information about Silbraz joints made with Walseal products, write for Circular A-1.

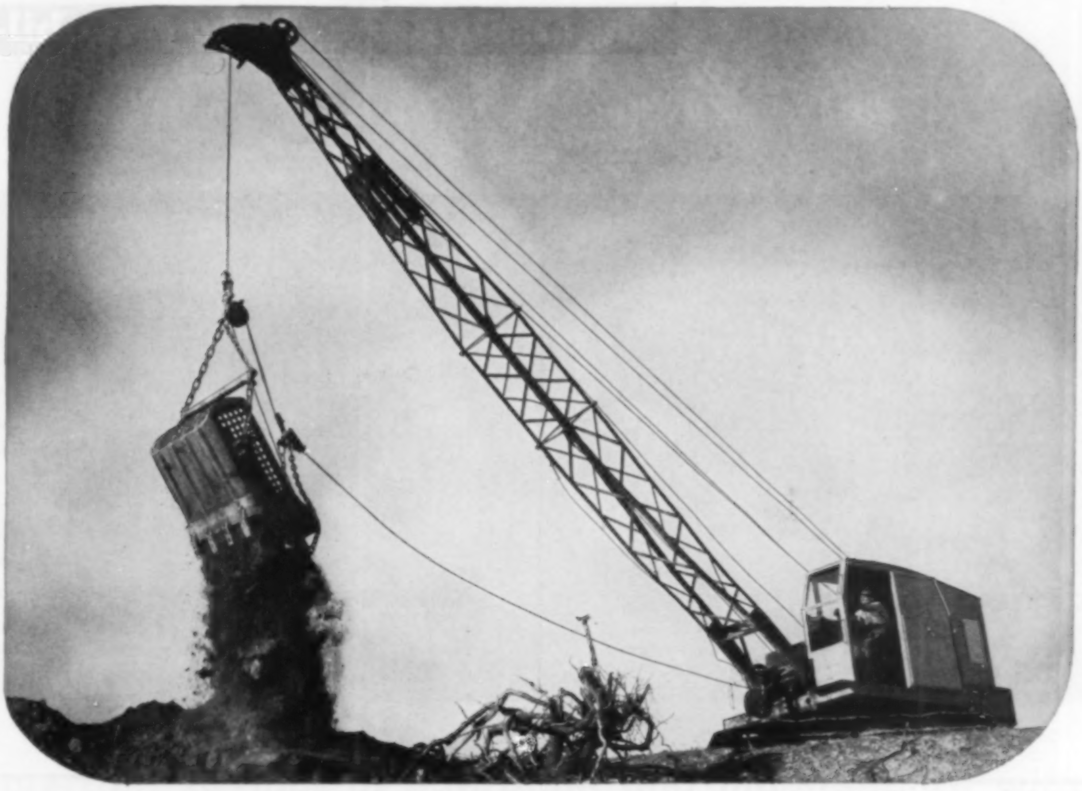
WALWORTH

valves and fittings

60 EAST 42nd STREET, NEW YORK 17, N. Y.

SEE OUR CATALOG IN SWEET'S

WIRE ROPE



This is the most economical rope we've ever made for construction equipment

ROEBLING is the best known name in wire rope. That's partly because we were the first wire rope maker in America. But more than that, we've always led in developing better wire and better rope for every purpose.

Today's Roebling Preformed "Blue Center" Steel Wire Rope is the best choice for efficiency and long life on excavating and construction equipment. This rope has *extra* resistance to crushing and abrasion . . . stands up under rough going. It saves you time and cuts costs.

There's a Roebling wire rope of the right specification for top service on any job. Call on your Roebling Field Man for his recommendations. John A. Roebling's Sons Company, Trenton 2, New Jersey.

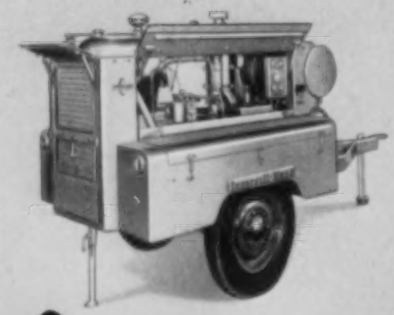
ATLANTA, 934 AVON AVE • BOSTON, 51 SLEEPER ST • CHICAGO, 5525 W. ROOSEVELT RD • CINCINNATI, 3253 FREDONIA AVE • CLEVELAND, 701 ST. CLAIR AVE, N. E. • DENVER, 4801 JACKSON ST • DETROIT, 915 FISHER BLDG • HOUSTON, 6216 NAVIGATION BLVD • LOS ANGELES, 5340 E. HARBOR ST • NEW YORK, 19 RECTOR ST • ODESSA, TEXAS, 1920 E. 2ND ST • PHILADELPHIA, 230 VINE ST • SAN FRANCISCO, 1740 17TH ST • SEATTLE, 900 1ST AVE S. • TULSA, 321 N CHEYENNE ST • EXPORT SALES OFFICE, TRENTON 2, N. J.

ROEBLING

JAR ROEBLING

NOW . . . GYRO-FLO

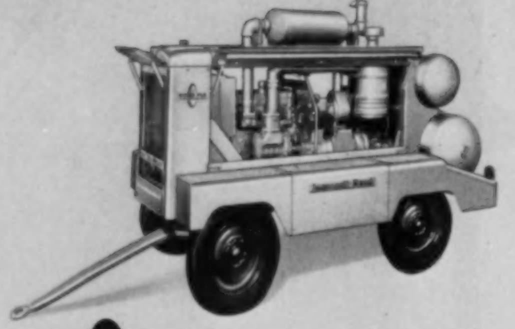
Ingersoll-Rand *Rotary* Mobil-Air



GYRO-FLO

105 cfm

Weighs only 2630 lbs., ready to run. Available matched to GM 2-51 diesel or Continental F-162 gasoline engine.



GYRO-FLO

210 cfm

Weighs only 4360 lbs., ready to run. Available matched to GM 4-51 diesel or Continental M-330 gasoline engine.

No other Portable Compressor offers you all these advantages!

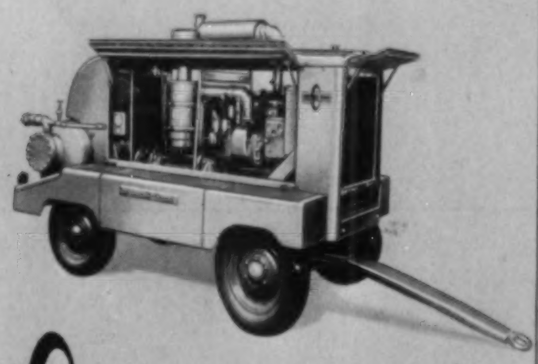
- **As much as 40% Lighter In Weight.** And as much as 20% smaller in overall size.
- **No Valves, Pistons, Rods Or Clutch.** No valves to leak, no reciprocating parts to wear out. Smooth, vibration-free operation.
- **Oil Injection Cooling.** Seals against air slippage and keeps discharge temperature below 200°F. Compressor cooling system independent of engine cooling.
- **Low Oil Consumption** throughout life of compressor. Oil injected into the air for cooling is removed by a separator and recirculated.
- **"Air-Glide" Capacity Control.** Provides smooth, stepless regulation of compressor capacity all the way from 0 to 100% output. Holds pressure within 10 psi range at all loads. Keeps engine at minimum speed.
- **Takes Full Advantage Of Modern Engine Speeds.** Compressor matched to nationally-known diesel or gasoline engines.

GYRO-FLO
is an addition to the

CONTRACTORS' COMBINATION

COMPRESSORS • AIR TOOLS
ROCK DRILLS • TURBO BLOWERS
CONDENSERS • CENTRIFUGAL PUMPS
DIESEL AND GAS ENGINES

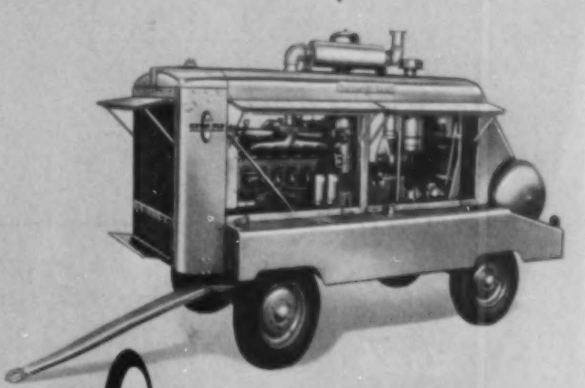
PORTABLE COMPRESSORS
IN 4 SIZES



GYRO-FLO

315 cfm

Weighs only 5200 lbs., ready to run. Available matched to GM 3-71 diesel or Continental B-427 gasoline engine.



GYRO-FLO

600 cfm

Weighs only 9500 lbs., ready to run. GYRO-FLO rotary compressor matched to powerful GM 6-71 diesel engine.

Important savings in operation and maintenance with this complete line of rotary compressors

"Better any way you look at it." That was the verdict of contractors everywhere when the 600 cfm GYRO-FLO compressor was introduced last year. And now—the same cost-saving advantages of the *rotary compressor* have been extended to three smaller sizes.

The GYRO-FLO is the most revolutionary design change during Ingersoll-Rand's 50 years of portable compressor history. The GYRO-FLO is far smaller—simpler—lighter in weight—and easier to maintain—than any other portable compressor heretofore available.

The features described on opposite page speak for themselves. And in actual on-the-job performance, GYRO-FLO compressors have repeatedly proved their dependability under the most rigorous operating conditions.

If you need more or cheaper air—go GYRO-FLO. Your nearest I-R representative will be glad to give you the whole story.

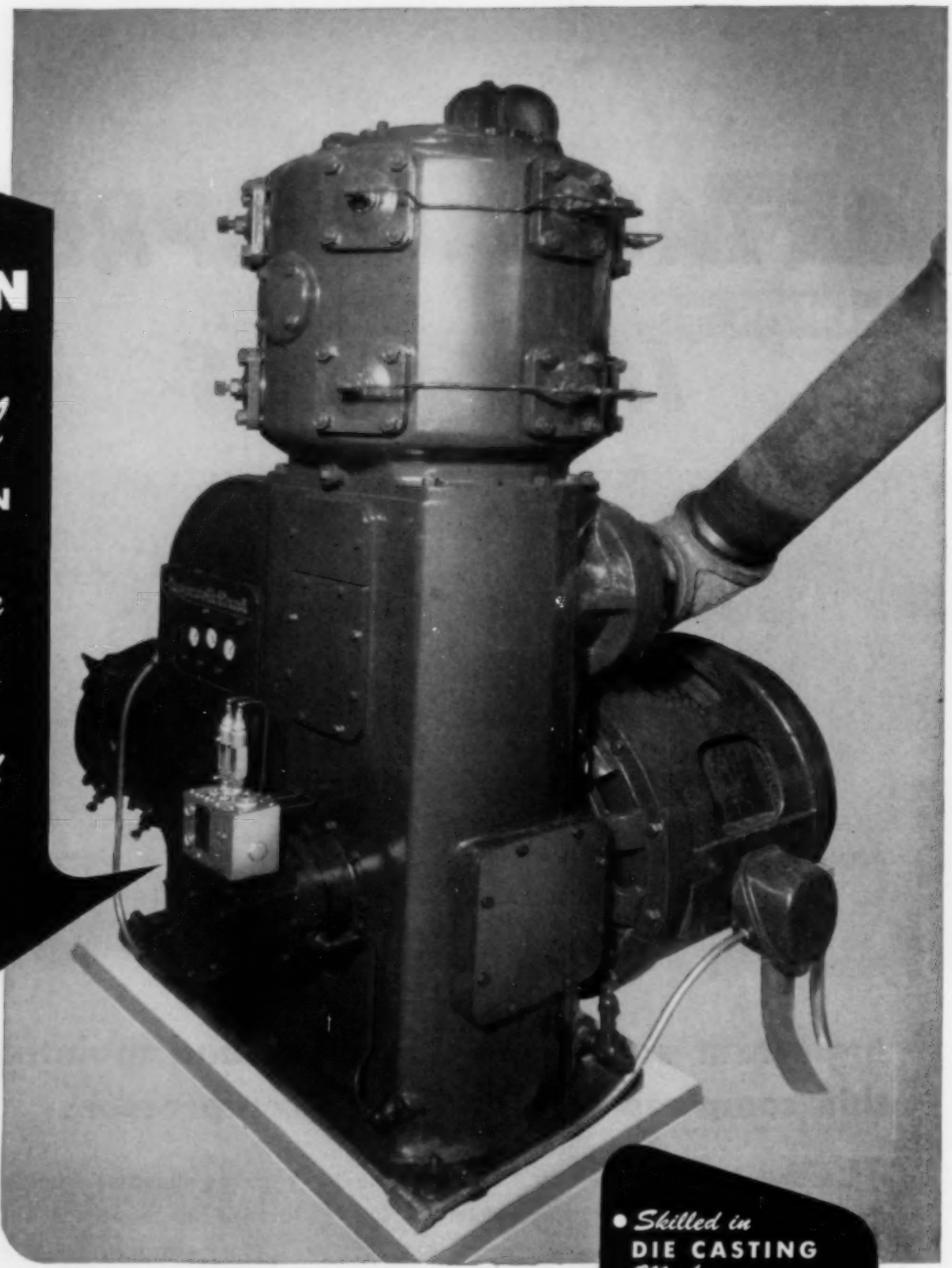
Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y.

765-2

MADISON -KIPP *fresh oil* LUBRICATION

fed under pressure by the measured drop!



Illustrated, the Madison-Kipp Model SVH Lubricator on an Ingersoll-Rand XLE Compressor.

- *Skilled in* **DIE CASTING** *Mechanics*
- *Originators of Really High Speed* **AIR TOOLS**
- *Experienced in* **LUBRICATION** *Engineering*

....STANDARD EQUIPMENT ON COMPRESSORS, WORK ENGINES AND MACHINE TOOLS....

Oil under pressure fed drop by drop from a Madison-Kipp Lubricator will definitely increase the production potential for years to come when applied as original equipment on new machine tools, work engines and compressors. There are six popular models for every application. Write for special engineering data for your particular requirement.

MADISON-KIPP CORPORATION

202 WAUBESA STREET, MADISON 10, WIS., U.S.A.

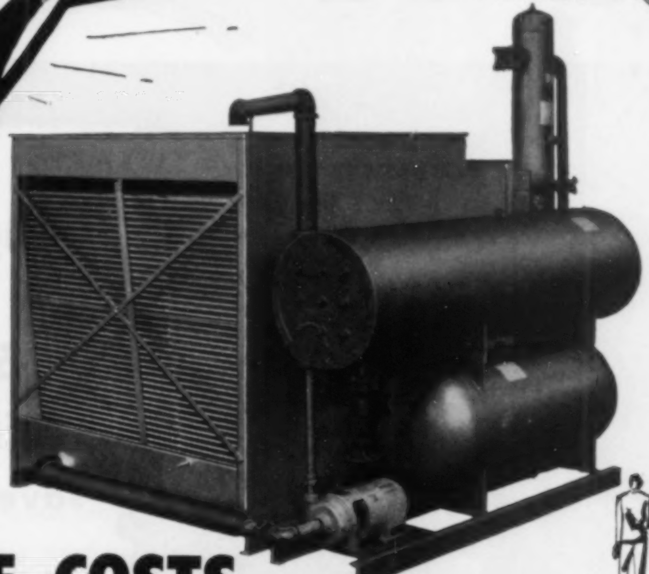
ANCIENS ATELIERS GASQUY, 31 Rue du Marais, Brussels, Belgium, sole agents for Belgium, Holland, France, and Switzerland.

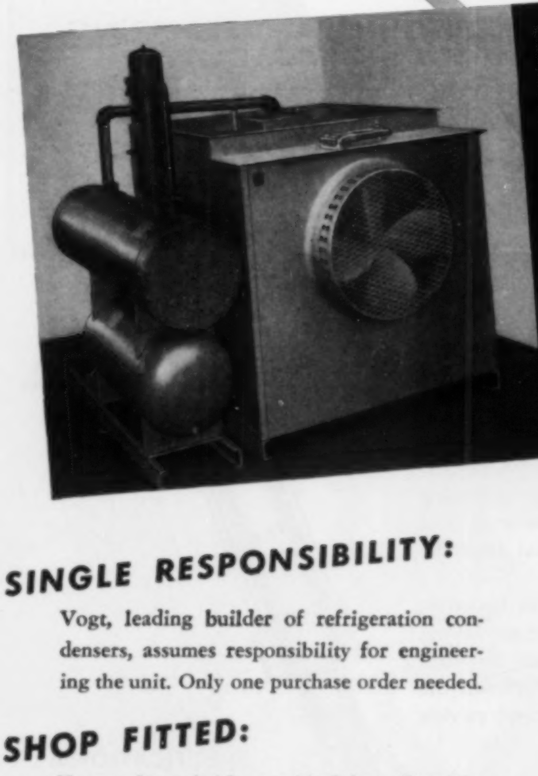
WM. COULTHARD & CO. Ltd., Carlisle, England, sole agents for England, most European countries, India, Australia, and New Zealand.

New

SAVES WATER and CUTS MAINTENANCE COSTS . . .

Illustrations show two views of a 35 ton Condenser Tower prior to partial disassembly for shipment.





Vogt CONDENSER TOWER

FOR CONDENSING REFRIGERANTS

SINGLE RESPONSIBILITY:

Vogt, leading builder of refrigeration condensers, assumes responsibility for engineering the unit. Only one purchase order needed.

SHOP FITTED:

To cut down field assembly labor. Requires no cutting or fitting of pipe.

Designed for today's water conservation requirements, and to keep refrigeration costs low, the *new* Vogt Condenser Tower meets the need for a proven, readily cleanable condensing unit.

The Vogt Condenser Tower consists of a multipass straight tube condenser, a receiver, an oil trap, a cooling tower, and a water pump. Removable cast iron heads permit easy cleaning of the condenser tubes.

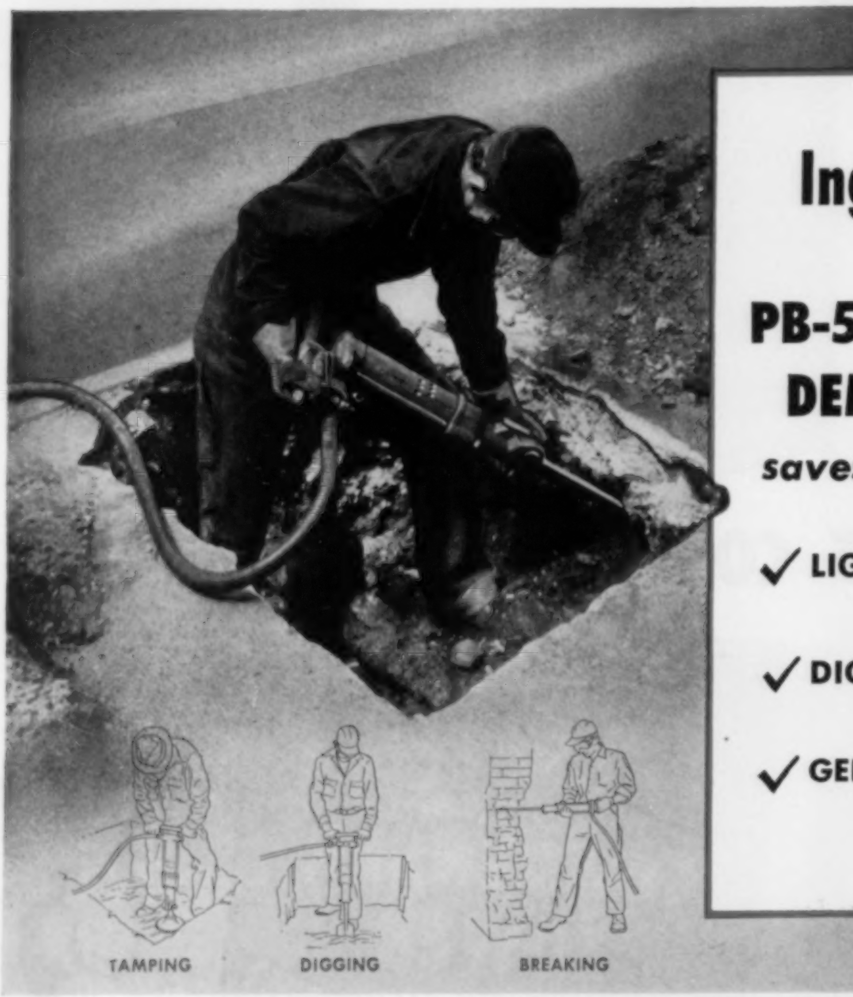
Water costs are extremely low since the cooling water is recirculated continuously and requires only a small amount of makeup to replace losses due to windage and evaporation.

Condenser Tower units are available in capacities ranging from 5 to 50 tons refrigeration. Additional information will be furnished upon request.

HENRY VOGT MACHINE CO., Louisville 10, Kentucky

BRANCH OFFICES: NEW YORK, PHILADELPHIA, CLEVELAND, CHICAGO, ST. LOUIS, DALLAS, CHARLESTON, W. VA.

NOW a light-weight tool for a man size job!



Ingersoll-Rand's *improved* PB-59 LIGHT-WEIGHT DEMOLITION TOOL

saves time and effort on

- ✓ **LIGHT PAVING WORK**
- ✓ **DIGGING AND TAMPING**
- ✓ **GENERAL DEMOLITION SERVICE**

Here's a compact, easy-handling Breaker that weighs *only 41 pounds*—yet has ample, hard-hitting power for a multitude of strenuous demolition jobs. The PB-59—most powerful machine in its weight class—will break up light concrete and tear out masonry blocks and brick work with ease. Its small size and light weight make the PB-59 easier and safer to handle on scaffolding jobs. And its low air consumption makes it particularly popular with the owners of small compressors.

With a complete line of standard accessories, including digging chisels, clay spades and tampers, the PB-59 demolition tool can also be used for loosening hard earth, as well as repacking and tamping the replaced material after the job is done.

Ask your I-R representative for complete information on this time-saving light-weight Breaker. Or send for your free copy of Bulletin No. 4127, on the complete line of Ingersoll-Rand paving breakers.

SPECIFICATIONS:

Weight	41 pounds
Length	23⅜ inches
Bore	1⅝ inches
Steel Size	1" Hex x 4¼
Air Connection	¾ inch

IR Ingersoll-Rand
11 BROADWAY, NEW YORK 4, N. Y. 794-5

ROCK DRILLS • COMPRESSORS • AIR TOOLS • CENTRIFUGAL PUMPS • TURBO BLOWERS • CONDENSERS • DIESEL AND GAS ENGINES

11
12
1
2
10
3
9
4
5
7
6

Ready Anytime

Eimco Loaders are ready to go to work anytime of the day or night. These heavy-duty units are built of strong alloy-steel castings, which are carefully machined and assembled. They are built to stay on the job, no matter how difficult or long it may be.

Write for information on jobs Eimco has done which may be similar to yours.

EIMCO A385

THE EIMCO CORPORATION

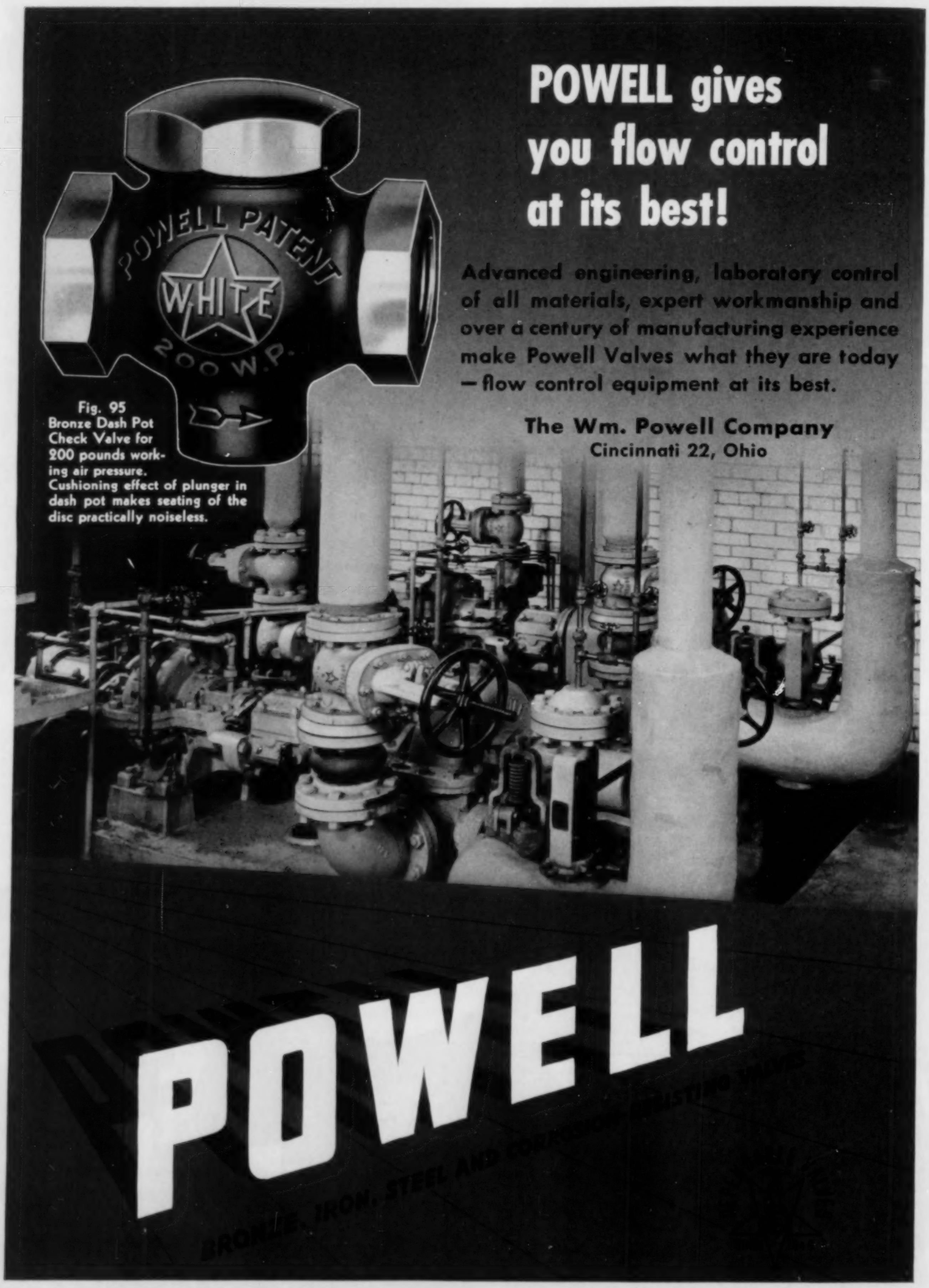
The World's Largest Manufacturers of Underground Rock Loading Machines

EXECUTIVE OFFICES AND FACTORIES — SALT LAKE CITY 10, UTAH, U. S. A.

BRANCH SALES AND SERVICE OFFICES:

NEW YORK, 51-52 SOUTH STREET • CHICAGO, 3319 SOUTH WALLACE STREET
BIRMINGHAM, ALA., 3140 FAYETTE AVE. • DULUTH, MINN., 216 E. SUPERIOR ST.
EL PASO, TEXAS, MILLS BUILDING • BERKELEY, CALIF., 637 CEDAR STREET
KELLOGG, IDAHO, 307 DIVISION ST. • LONDON W. 1, ENGLAND, 190 PICCADILLY

IN FRANCE: SOCIETE EIMCO, PARIS, FRANCE
IN ENGLAND: EIMCO (GREAT BRITAIN) LTD., LEEDS 12, ENGLAND
AGENTS IN ALL PRINCIPAL CITIES THROUGHOUT THE WORLD

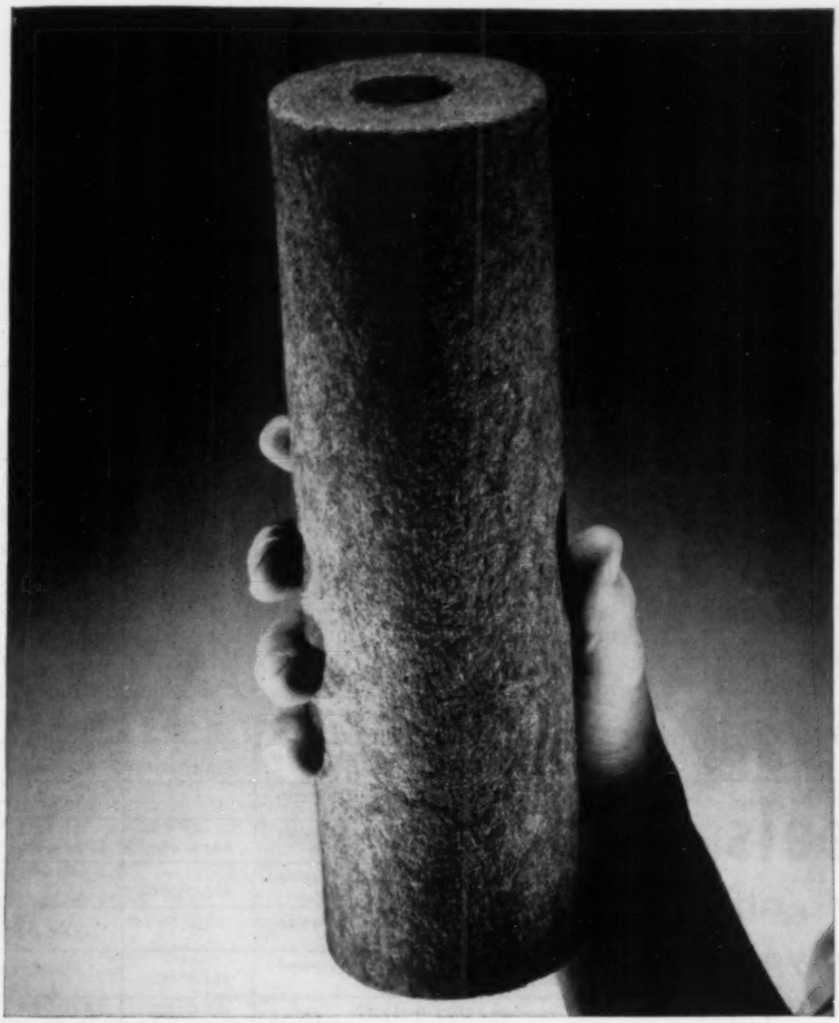

POWELL PATENT
WHITE
200 W.P.
POWELL
BRONZE, IRON, STEEL AND CORROSION RESISTING VALVES

POWELL gives you flow control at its best!

Advanced engineering, laboratory control of all materials, expert workmanship and over a century of manufacturing experience make Powell Valves what they are today —flow control equipment at its best.

The Wm. Powell Company
Cincinnati 22, Ohio

Fig. 95
Bronze Dash Pot Check Valve for 200 pounds working air pressure. Cushioning effect of plunger in dash pot makes seating of the disc practically noiseless.



The Simplest Filter Cartridge Lasts the Longest...Twice as Long

Cartridge renewals are cut at least *in half* when Cuno MICRO-KLEAN replaces any other filter. And throughout its service life, MICRO-KLEAN is *guaranteed* for specific performance.

Protect Air-operated Equipment Against Moisture and Dirt

The positive way to remove moisture and dirt from compressed air lines is to use the Cuno MICRO-KLEAN Air Line Filter.

This unique cartridge-type filter removes all entrained moisture, plus all foreign particles (dirt, pipe scale and other trash) down to 1 micron in size.

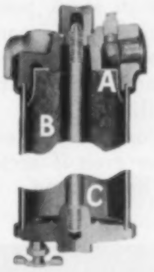
The dry, clean air assures more satisfactory performance—and longer life—of pneumatic tools, instruments, paint spray systems, hoists, etc.

Less Work for You

The Cuno MICRO-KLEAN Air Line Filter does its work with less attention required from you because its cartridge needs replacement only half as often.

The resin-impregnated fibres are non-wicking, so the trapped moisture drains promptly. The extra-large moisture-collecting area means less frequent draining.

Pressure drop across the cartridge is slight due to the openness of the structure—80 to 90% porosity—and to the absence of purely structural components (none needed) that offer resistance to flow.



A. Baffle deflects some moisture down outside cartridge.

B. Network of fibres catches remaining moisture and dirt as air works its way through interstices.

C. Trapped moisture drains into collection chamber.

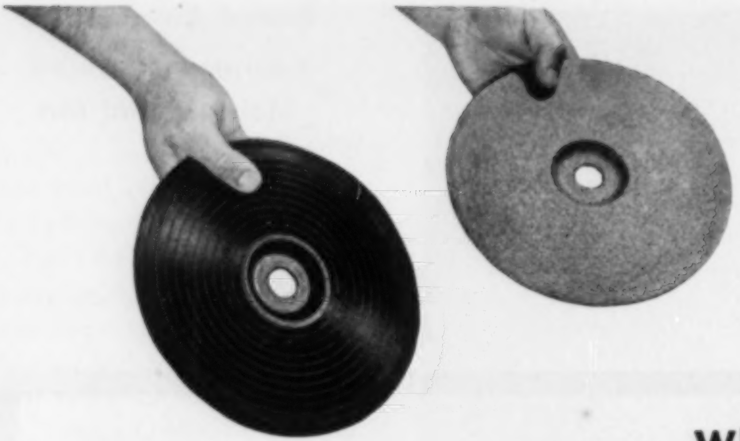
Cuno Engineering Corporation
Dept. 177C, South Vine Street, Meriden, Conn.
Please send information on Cuno MICRO-KLEAN
Air Line Filter for ....
Name.....................Title........
Company...................................
Address...................................
City................Zone....State....
Please attach to your business letterhead

CUNO

Fluid Conditioning

Removes More Sizes of Solids from More Kinds of Fluids

Strain fuels, lubricants, process fluids, etc.—AUTO-KLEAN
Filter fuels, lubricants, process fluids, etc.—MICRO-KLEAN
Clean raw water, recirculating water, etc.—FLO-KLEAN



Handiest pair for portable grinding! With Norton BD rigid and BFR *semi-flexible REINFORCED RESINOID* Hub Wheels always on hand, you'll do more jobs better with your standard portable grinders and sanders than ever before. Faster, easier and safer, too! Try them and see.

FASTER, EASIER, SAFER

for your portable grinding

These 2 Multi-Job NORTON *reinforced* hub wheels

save time, work, and money on dozens of your jobs

Lighter and easier to use than cup wheels. Longer lasting than coated abrasive discs. More versatile than either! That's the handiest team in weld grinding . . . the time-tested Norton BD rigid hub wheel and the sensational new Norton BFR semi-flexible hub wheel.

Use the new Norton BFR for jobs where finish is more important than stock removal. You'll like the way it hugs the corners and contours.

Use the time-tested Norton BD for jobs where stock removal is more important than wheel flexibility. It's built to take it.

Both are nylon-web-reinforced for extra safety. They hold together even if accidentally cracked until the machine can be stopped.

What Versatility!

Just a few of the jobs you can do with the handiest pair for portable grinding. Where both types of wheels are indicated choice depends on the nature of the job.

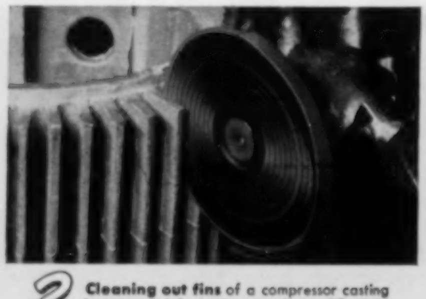
THE JOB	BD RIGID	BFR* SEMI-FLEXIBLE
Removing rust and scale, scarfing and beveling before welding	A24-O14BD	A24-K BFR
Cutting away, smoothing and blending welds on fabricated work	A36-O14BD	A24-K BFR
Making V cut to remove old weld materials for salvaging steel parts	A24-R14BD	
Removing burrs and sharp edges from steel sheets and plates	A36-R14BD	A24-K BFR
Roughing off excess weld material before smoothing with coated abrasive discs	A24-O14BD	A24-K BFR
Cutting off gates and risers on brass, bronze and aluminum castings		A24-K BFR
Notching large gates and risers on all kinds of castings	A24-R14BD	A24-K BFR
Cleaning between teeth of large marine and industrial gears	A36-O14BD	
Removing mold marks and smoothing castings before painting		A24-K BFR
Smoothing flame-cut edges on heavy steel sheets and plates	A24-R14BD	
Smoothing stainless steel welds	A24-O14BD	A24-K BFR
Smoothing and blending copper, bronze, aluminum and stainless steel surfaces	A24-O14BD	A24-K BFR

*A24-K BFR is considered a good all around specification but for jobs where finish is not important 16 grit will give somewhat longer wheel life.

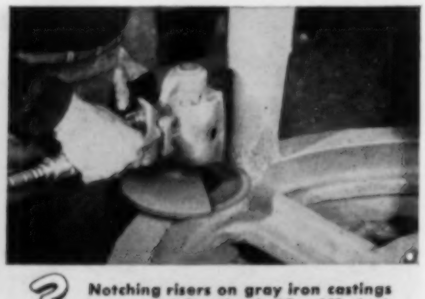
Ask your nearby Norton Distributor for a demonstration or write for new Bulletin 225. NORTON COMPANY, Worcester 6, Mass. Distributors in all principal cities. EXPORT: Norton Behr-Manning Overseas Incorporated, Worcester 6, Mass.

NORTON
ABRASIVES
Making better products to make other products better

1. **Smoothing out a welded radius** calls for a work-hugging Norton BFR semi-flexible wheel.



2. **Cleaning out fins** of a compressor casting is a tough job made easy by a BD rigid wheel.



3. **Notching risers on gray iron castings** is an easy job for either the BD or BFR wheel. Take your choice.

ON THE COVER

WHEN the USS *Pickerel* came to the surface from a depth of 150 feet off Oahu, T. H., she put on quite a show. The action pictured took place during a routine training exercise and was designed to further evaluate the capabilities and characteristics of this type of submarine. A sub is brought to the surface primarily by changing her buoyancy. This is usually done by introducing air, compressed to 3000 psi, into the ballast tanks to expel the water. Streams can be seen issuing from openings in the bow.

The *Pickerel* was built at Mare Island, Calif., and joined the fleet in 1948. She was converted to a Guppy-II (Greater Underwater Propulsion) in 1949. Since then she has been operating under the control of the Commander Submarine Force, Pacific Fleet.

●

IN THIS ISSUE

THE Aluminum Company of Canada became accustomed to thinking in big terms during World War II, when it built the mammoth Shipshaw power development, an undertaking which, incidentally, was given no publicity until fighting ceased. Its latest project, the venture in British Columbia that we begin describing in this issue, is big in every way—in conception, financing, territory covered and the volume of aluminum that will result. In these days of huge government jobs, it is refreshing to come across one of this magnitude that will be paid for solely by private industry.

There is a point of similarity between this scheme and the Colorado-Big Thompson Project of the Bureau of Reclamation in the United States. Both are based on reversing the natural flow of runoff water by tunneling through a mountain range. In Colorado the diversion is being made to irrigate crops, with power generation secondary; in Canada power production is the sole objective.

H. R. Rice, author of our 3-part article (the second installment will appear next month), was on the job for a week gathering material at first hand. He is a mining engineer who has recently turned to journalism. Following his graduation from Queen's University, Kingston, Ont., he worked for seven years at various Canadian mining properties, then spent three years at the Roan Antelope Mine in Rhodesia, South Africa. In 1941 he joined the staff of John Taylor & Sons, British consulting engineering and management concern, for which he developed gold mines in Hyderabad State, India, for a period of six years. He returned to North America in 1947, took a year's post-graduate course at Columbia University, New York, and then joined the staff of *Canadian Mining Journal* as associate editor. He was made editor early in 1951.

Compressed Air Magazine

COPYRIGHT 1952 BY COMPRESSED AIR MAGAZINE COMPANY

VOLUME 57 **August, 1952** NUMBER 8

G. W. MORRISON, *Publisher*
C. H. VIVIAN, *Editor*
J. W. YOUNG, *Director of Advertising*
ANNA M. HOFFMANN, *Associate Editor*
J. J. KATARBA, *Business Mgr.*
J. C. PIERCE, *Assistant Editor*
A. W. LOOMIS, *Assistant Editor*
D. Y. MARSHALL, Europe, 243 Upper Thames St., London, E. C. 4.
F. A. MCLEAN, Canada, New Birks Building, Montreal, Quebec.

EDITORIAL CONTENTS

Aluminum Venture in British Columbia, Part 1—*H. R. Rice* 214
Air-expanded Mandrel Stiffens Long Piles 221
Hand-made Brushes—*Fremont Kutnewsky* 223
Modern Air-Gauging—*J. C. Pierce* 225
Jets of Oil Speed Metal Cutting 227
Rotary Compressor Speeds 'Gunite' Application 229
Further Delving into the Supernatural 230
Editorials—Climate and Industry—Huge Drainage Scheme 231
This and That 232
The Docter Looks into You—*J. D. Ratcliff* 233
Machine Shop on Wheels 234
Radioactive Air Gun Neutralizes Static Electricity 234
Industrial Notes 235
Quotes from Here and There 239
Books and Industrial Literature 241

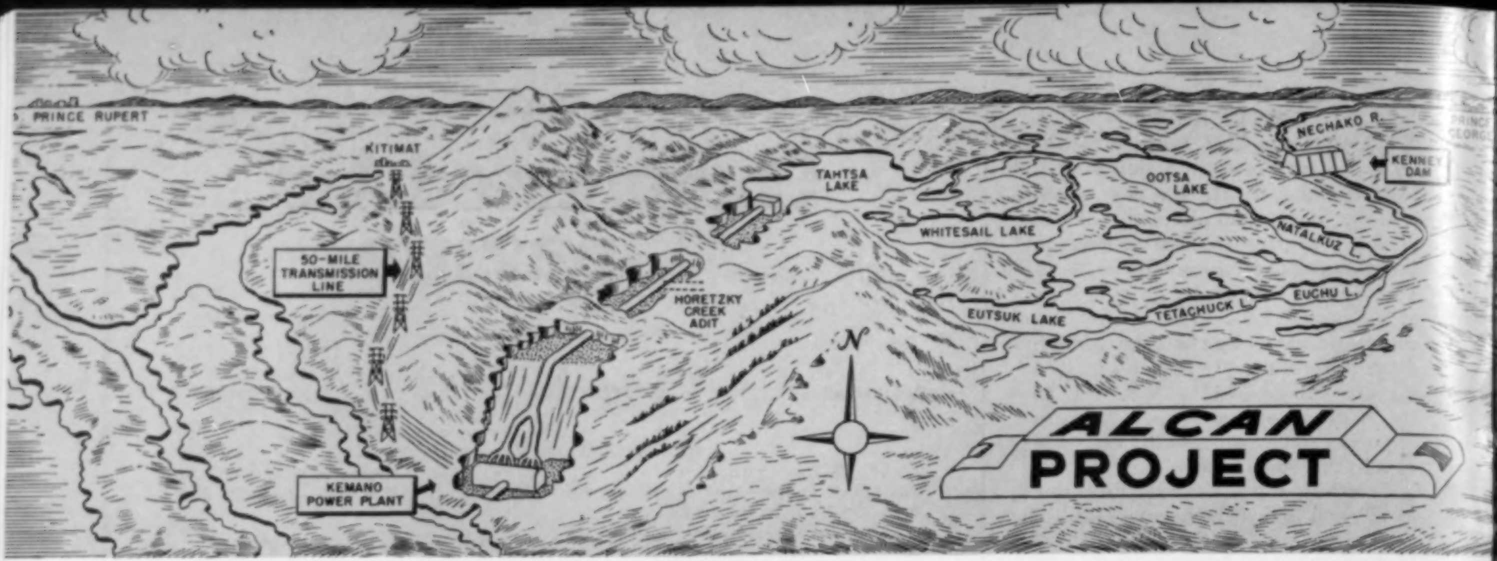
ADVERTISING CONTENTS

Allis Company, The Louis 34
American Air Filter Co., Inc. 25
Armstrong Machine Works 30
Barksdale Valves 15
Bethlehem Steel Company 23
Bucyrus-Erie Company 33
Compressed Air Magazine Co. 30
Cook Mfg. Co., Inc. C. Lee 22
Crucible Steel Co. of America 26
Cuno Engineering Corporation 13
DeZurik Shower Company 32
Dollinger Corporation 3
du Pont de Nemours & Co., E. I. 24
Eimco Corporation, The 11
Hunt & Son, Inc., C. B. 35
Industrial Clutch Corporation 30
Ingersoll-Rand Company 6, 7, 10, 28, 3rd cover
Madison-Kipp Corporation 8
Maxim Silencer Co., The 16
National Forge & Ordnance Co. 31, 32
Naylor Pipe Company 20
New Jersey Meter Company 29
Nicholson and Company, W. H. 31
Norton Company 14
Nugent & Co., Inc. Wm. W. 19
Powell Company, The Wm. 12
Roebling's Sons Company, J. A. 5
Sarco Company, Inc. 29
Sauerman Bros., Inc. 29
SKF Industries, Inc. 27
Texas Company 2nd Cover
Timken Roller Bearing Co., The Back Cover
Victaulic Company of America 17
Vogt Machine Company, Henry 9
Waldron Corporation, John 21
Walworth Company 4
Waukesha Motor Company 18
Wood's Sons Co., T. B. 31

A monthly publication devoted to the many fields of endeavor in which compressed air serves useful purposes. Founded in 1896.

CCA Member Controlled Circulation Audit

Published by Compressed Air Magazine Co., G. W. MORRISON, *President;*
C. H. VIVIAN, *Vice-President;* A. W. LOOMIS, *Vice-President;*
J. W. YOUNG, *Secretary-Treasurer.*
Editorial, advertising, and publication offices, Phillipsburg, N. J.
New York City Office, 11 Broadway. L. H. GEYER, *Representative.*
Annual subscription: U.S., $3.00, foreign, $3.50. Single copies, 35 cents.
COMPRESSED AIR MAGAZINE is on file in many libraries and is indexed in Industrial Arts Index and in Engineering Index.



COPYRIGHT 1952 BY MORRISON-KNUDSEN COMPANY, INC.

ESSENTIALS OF SCHEME

Although there is a lot to the Alcan development and it will be spread over an area of 160x60 miles, the scheme is fundamentally simple, as this drawing shows. By erecting Kenney Dam (upper right) on the Nechako River, water that normally flows eastward will be backed up into a vast storage reservoir consisting of seven interconnected lakes. From Tahtsa Lake, westernmost of the group, a 10-mile tunnel will convey the water through the range, whence it will drop 2600 feet through penstocks to generate electricity in the Kemano underground powerhouse. From Kemano a high-tension line will carry the current northward to the yet-to-be-built seaport of Kitimat, where it will be used to produce aluminum. The region concerned is rugged and isolated, and most supplies are going in from Vancouver, largest British Columbia city some 400 miles to the south. North of Tahtsa Lake and not shown on this map are Nanika, Kidprice and Morice lakes, connected links in a catchment basin that drains through the Skeena River to the Pacific Ocean. At some later time it is proposed to create a supplemental reservoir by damming the outlet of Kidprice Lake, thus raising the water level to Elevation 3106. Water thus impounded will be diverted to Tahtsa Lake through a 13-foot-diameter tunnel 3.8 miles long.

Aluminum Venture in British Columbia

Canadian Company Spending Half-Billion Dollars on Gigantic Power Scheme and Smelter

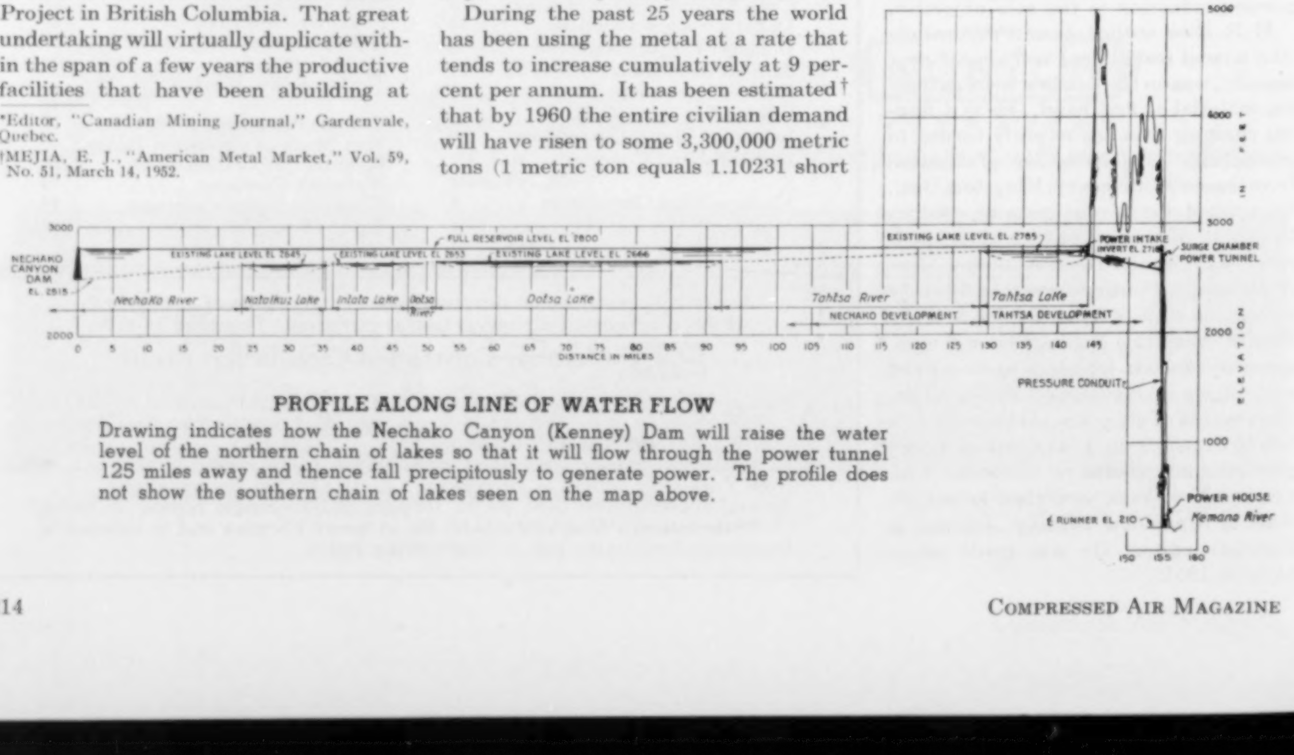
H. R. Rice*

Part 1

> "My ventures are not in one bottom trusted, nor to one place."
> —SHAKESPEARE

A LITTLE more than a year ago, in June, 1951, and after a period of intensive planning occasioned by the magnitude of the enterprise, the Aluminum Company of Canada embarked on the Nechako-Kemano-Kitimat Project in British Columbia. That great undertaking will virtually duplicate within the span of a few years the productive facilities that have been abuilding at Arvida, Shawinigan, Isle Maligne and Beauharnois over the past half-century and will involve an ultimate capital expenditure of somewhat more than $500 million. Before touching upon some of the superlatives that are naturally inherent in a project of this size, it seems proper to examine it in the light of what it means to Canada in her position as a provider of primary aluminum.

During the past 25 years the world has been using the metal at a rate that tends to increase cumulatively at 9 percent per annum. It has been estimated† that by 1960 the entire civilian demand will have risen to some 3,300,000 metric tons (1 metric ton equals 1.10231 short tons), as compared to the present consumption of 1,720,000 tons. By that time world production is expected to reach 2,700,000 tons, and this allows for the completion of all plants now under construction and then contemplated. On that basis, and with a capacity of about one million tons per year, the Dominion will be the largest single producing coun-



PROFILE ALONG LINE OF WATER FLOW

Drawing indicates how the Nechako Canyon (Kenney) Dam will raise the water level of the northern chain of lakes so that it will flow through the power tunnel 125 miles away and thence fall precipitously to generate power. The profile does not show the southern chain of lakes seen on the map above.

---

*Editor, "Canadian Mining Journal," Gardenvale, Quebec.

†MEJIA, E. J., "American Metal Market," Vol. 59, No. 51, March 14, 1952.

VALLEY OF THE KEMANO

In years to come, near the point where the photographer stood, water brought by tunnel from the eastern (right) side of the coast range will begin its drop of nearly half a mile through penstocks leading to the turbines of the world's largest underground powerhouse. The current generated will be carried up the valley and across the mountains in the center to Kitimat, 50 miles away, where the Aluminum Company of Canada will use it to process alumina. The 300,000-volt transmission line will cross Kildala Pass at an altitude of 5300 feet. To withstand severe winter icing, the cable will be of aluminum reinforced with steel and of a record diameter of 2.26 inches.

try (37 percent of the world's total) and the Aluminum Company of Canada (Alcan) the largest single producer.

The project includes the biggest hydroelectric power development ever financed entirely by private capital. It will have an ultimate capacity of 1,200-000 kw from an installed mechanical capacity of 2,240,000 hp of which 226,-000 kw will, it is expected, be available early in 1954 for the production of aluminum at an initial rate of 83,000 metric tons per annum. Further, it is a model of Canadian enterprise, as it is being financed by Alcan's own resources, encouraged and augmented by interest-bearing loans advanced by the British Government against firm long-term deliveries of metal over the next several years. In this respect, perhaps, it represents a departure from established practice in some countries, for no United States funds are involved.

The undertaking and the manner in which a great industry is being created in an area of British Columbia that has hitherto been considered as rather remote, point to considerable financial courage and engineering audacity on the part of Alcan. Tribute is also due to the excellent work that has been done on a continuing basis over the years by both Dominion and Provincial hydrographic and other services, the general quality and reliability of whose records go far towards encouraging private capital to take such large risks which, while not yet by any means commonplace, have come to arouse a rather diminishing measure of surprise in any contemplation of the Canadian economic scene.

This account, which is based on a 7-day visit to the Kemano side of the project, will include the broader aspects

---

IN PREVIOUS articles we have told of the great Canadian facilities for the manufacture of aluminum that have been built up in the past 50 years at Arvida, Shawinigan Falls, Isle Maligne and Beauharnois, all in the Province of Quebec. In 1951 those works produced some 406,000 metric tons of the metal, or nearly one-quarter of the world's output, and plant additions under construction or projected for the next two years will bring the annual capacity of the eastern facilities of the Aluminum Company of Canada to slightly more than 500,000 metric tons per annum.

Canadians are justly proud of the great enterprise that has thus grown up through the wise development and application of electric power—the most important single "raw material" in aluminum ingots—and placed them in an enviable position among countries producing the light metal.

Now, as told in this article and two that will follow, Alcan has crossed the Dominion to the forest wilderness of British Columbia and is there planting the roots of a vast new hydroelectric development and aluminum smelter that will surpass any facilities of the kind previously built.

ROAD BUILDING

Access roads, including one of 104 miles and another of 60, had to be pushed through before construction could start in earnest, although the airplane and helicopter were much used meanwhile for transport. On the Kemano-Horetzky road, two new-model Canadian Ingersoll-Rand portable compressors (right) furnished air for rock drills, and an I-R air-powered woodborer (below) drilled logs for use in bridge construction.

of the development, in combination with the more salient engineering features. During that time courtesies were received from many busy men who are officials of the Aluminum Company of Canada, proprietors; Morrison-Knudsen Company of Canada, general contractor for the power project; Kitimat Constructors, contractors on the smelter and townsite at Kitimat; and British Columbia International Engineering Company, general consulting engineers.

General Considerations and History

The production of aluminum ingots requires approximately 10 kwh per pound of metal, or 22,046 kwh per metric ton. The principal physical raw material is the aluminum hydroxide, bauxite, of which about 4 pounds has to go through the alumina or oxide stage and then through the molten electrolytic reduction process for each pound of ingot. Bauxite of commercial grade and abundance is found in large part in tropical and subtropical regions, so that the entire bauxite-to-metal production line is predicated on two major factors—low-cost water transport of either bauxite or alumina to a smelter which has large quantities of low-cost electrical energy close at hand.

These conditions obtain at Arvida in Quebec, and also in general at the site now being built upon in the Kitimat-Kemano area in British Columbia. When the Kitimat smelter is placed in operation, bauxite mined in British Guiana and Jamaica and processed to alumina in a Jamaican plant now under construction by a subsidiary of the parent company, Aluminum Limited, will be brought by ocean transport across the Caribbean, through the Panama Canal, and thence along the west coast to the deep-water terminus being made available at Kitimat, which is some 400 miles north of the City of Vancouver.

In 1928-31, and again in 1937-39, the British Columbia Department of Lands and Forests carried out intensive surveys of the watersheds lying to the east of the coast range of mountains. The published reports of those surveys were read assiduously by Alcan engineers, then preoccupied with the expansion of their plants in eastern Canada. Not until 1948 were field investigations started by the company to determine the feasibility of utilizing the potential hydroelectric resources lying near the west coast. Through the following two years, intensive surveys and examinations of meteorological and stream-flow data were conducted, culminating in a decision, taken early in 1951, to proceed with the immediate construction of a smelter and its attendant services at Kitimat. An accompanying map shows the locations of the various works comprising the project as a whole.

Selection of the Area

The selection of the Kitimat-Kemano area was based primarily on the general physiographic features of the country. There the steeply indenting valleys of the coast range reach sea level close to or, in some places, even slightly east of its crest, while the eastern slopes of the range form easterly draining watersheds containing modest though adequate quantities of water at great hydraulic heads with respect to sea-level elevations. In this case particularly the watershed is well within reasonable reach of the fiords by means of properly engineered impounding and diversion works.

At Kitimat, itself, an alluvial plain at the mouth of the Kitimat River has unique proportions for this stretch of the British Columbia coast and offers the several square miles of virtually level space required for a smelter and townsite of the size needed. Deep water for ocean transport is available throughout the Douglas Channel and Kitimat Arm to within a few hundred yards of the smelter site, for nearly all the fiords extending from Douglas Channel are open to sea-going vessels.

Kitimat will also be well situated with regard to railway transport direct to eastern Canada by way of a 40-mile branch line which is soon to be built by the Canadian National Railways from Terrace, a station on the Jasper-Prince Rupert line. In this connection it is of interest to note that Kitimat was initially proposed as the western ter-

WATER SUPPLY AND RESERVOIR AREAS

Watershed	Regulated Flow cfs	Reservoir Areas sq miles Natural	Flooded	Total	Regulating Storage 000,000,000 cu ft
Tahtsa	925	20.1	1.7	21.8	27.8
Nechako	5075	158.5	176.5	335.0	127.2
Nanika-Kidprice	920	14.5	5.9	20.4	21.3
Totals	6920	193.1	184.1	377.2	176.3

minus of the Grand Trunk Western Railway during the great period of transcontinental railroad construction 50-odd years ago and was only superseded by Prince Rupert after close economic and political consideration.

KENNEY DAM SITE

Here, at the eastern end of the 160-mile-long area under development, the third highest rock-fill dam yet built will rise 324 feet to block the Nechako River. Its purpose will be to back up eastward flowing water in a 7-lake connected reservoir with a high-water surface 2800 feet above sea level. The reservoir will have a full-pool area of 350 square miles and four years will be required to fill it. Mannix Limited, a Canadian contracting firm, began work on the 4-million-cubic-yard structure in April, 1951, and had diverted the flow of the Nechako around the left abutment by October of that year. The dam is being named for E. T. Kenney, minister of lands and forests in British Columbia.

Watersheds

Lying to the southeast of Kitimat, and on a plateau that tilts comparatively gently toward the east, is a section roughly coinciding with Tweedsmuir Park and containing three main watersheds aggregating some 5475 square miles. The two principal catchment areas are drained through long, narrow chains of lakes into Natalkuz Lake and thence into the Nechako River, one of the headwater tributaries of the Fraser. The third watershed, north of the general Tweedsmuir Park region, finds natural drainage along Nanika, Kidprice and Morice lakes to the Skeena River, which reaches the Pacific Ocean at Prince Rupert.

The topographical expressions of these watersheds are such as to preclude the flooding of large stretches of land by building adequate storage reservoirs, and this is indicated both in the accompanying map and table of the regulated flow, natural and flooded reservoir sections, and the regulating storage for the three main drainage areas. The total acreage that will be artificially flooded amounts to about 117,900, comprising 9300 acres of private lands, 500 acres of Indian Reserves, and 108,100 acres of Crown Lands. This amounts to but 3.37 percent of the watersheds. All reasonable assistance is being offered by Alcan to those who may wish to clear away timber in advance of flooding, though the timber, in general, is not available in varieties or quantities suitable for commercial purposes.

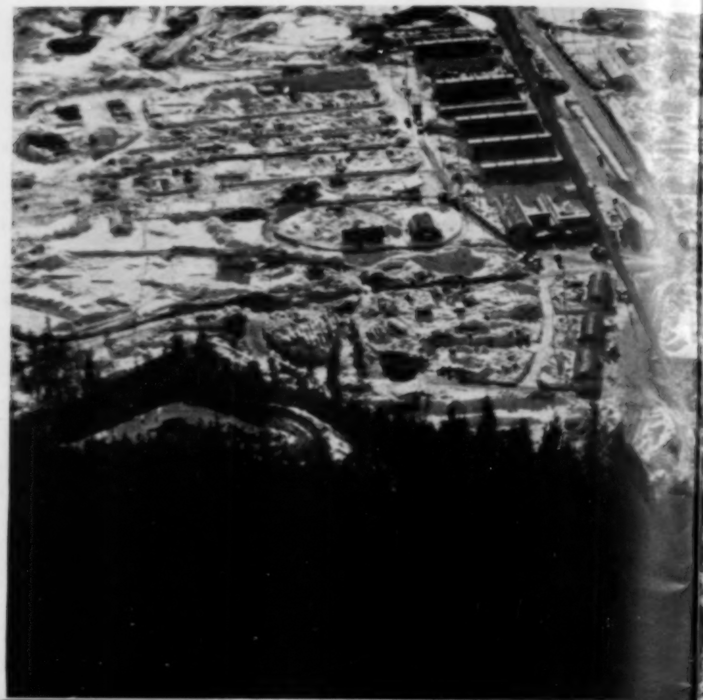
WHERE ALUMINUM SMELTER WILL RISE

Stripping and clearing the site of the reduction works at Kitimat that will have an initial capacity of 83,000 metric tons of aluminum metal annually and may eventually reach 500,000 tons. Once an Indian village, Kitimat is rising as a new city with a population of 7000 forecast for 1954, mushrooming to 50,000 by the time the smelter is operating at top capacity. Raw material will come from Jamaica, where a plant is going up to perform the intermediate step of reducing bauxite ore to alumina. This will cut transportation to Kitimat in half. Alumina-laden boats from Jamaica will move through the Panama Canal and thence up the Pacific Coast, reaching Kitimat by way of the Douglas Channel.

An accompanying drawing shows the profiles along the principal drainage routes, which extend from the Grand Canyon of the Nechako River to the headwaters at the western end of Tahtsa Lake, an over-all distance of 145 miles. The various estimates of the available water supply are based on hydrographic data collected by government agencies during the past twenty years and have been both continued and extended through detailed surveys made of all the contributing factors by Alcan's engineers since the conception of the project back in 1948.

Impounding

The whole scheme involves the impounding of all waters naturally draining through the northern and southern chains of lakes to an elevation of 2800 feet above sea level by means of the Kenney Dam in the Nechako River Canyon and feeding to the basin so formed the waters of the Nanika-Kidprice system. Eventually there will thus be created a continuous reservoir from the head of Tetachuk Lake to the intake works at the head of Tahtsa Lake, a distance of nearly 200 miles. To fill this area, some 873,000 million cubic feet of water will be required, and with



CANADA WIRE & CABLE

the closing of the Kenney Dam diversion tunnel in September of this year it is expected that the full reservoir level will be reached in June, 1957.

Nanika-Kidprice System

In order to convey the waters of lakes Nanika and Kidprice to the main reservoir at Tahtsa Lake, it will be necessary to excavate a tunnel 13 feet in diameter and 3.8 miles long. This diversion also calls for a dam at the outlet of Kidprice Lake so as to raise the waters of this relatively minor system to Elevation 3106, or 10 feet above its natural level. Other lesser works include small dams and embankments at different places along the rim of the main reservoir. The most important of these will have a spillway that will return to the Nechako River up to 30,000 cfs (cubic feet per second) of any excess over reservoir requirements.

Diversion and Power Generation

Situated some 50 miles from the smelter site at Kitimat is Kemano Bay at the mouth of the river of the same name. Accessible therefrom over a 10-mile motor road constructed as part of the project is a point near the confluence of Kemano River and Horetzky Creek that has natural advantages as the site of an underground power station. The location is 10.1 miles from the western end of Tahtsa Lake, and a 25-foot-diameter diversion tunnel is being driven at this initial stage so the impounded waters can be brought to the generators as they are installed. The full development of the scheme envisages a second paralleling tunnel. For the present, however, No. 1 Power Tunnel is being pushed towards completion scheduled in October of next year.

AERIAL TRANSPORT

From Kemano, men and materials are elevated to the 1600- and 2600-foot levels, where adits give access to the interior of the mountain for driving the penstock and main power tunnels. The tram's 9-ton skip will carry 85 men or 20 tons of freight. Next on the left is a view down the line from high on the mountain. As the skip comes in for a landing, bottom-left, it is on an angle and is brought to an even keel for unloading and loading by means of two Ingersoll-Rand Utility air hoists—one at each end of the leading edge. A close-up of one of them and its attendant is in the opposite corner.

Initial Power in 1954

The first power-development stage, using Tahtsa Lake water only while the main reservoir is filling, will entail a draft commencing in May, 1954, of 925 cfs through the main tunnel to the turbines in the Kemano underground station, set at Elevation 210. The three machines to be installed for this initial stage will each have a mechanical rating of 140,000 hp, or a total of 420,000 hp, and, together, will be capable of delivering 234,000 firm kw on the powerhouse low-tension busses, or 226,000 kw on the high-tension busses at the Kitimat smelter 50 miles distant. These units will be of the vertical, single-runner, 4-nozzle impulse type, running at 327 rpm.

As the various elements of the scheme are brought into service, it is estimated that, with 6920 cfs of water available under a net head of 2497 feet, 1,718,000 electrical hp can be generated by the proposed installed capacity of sixteen units totaling 2,240,000 mechanical hp. As previously pointed out, this amount of power could be made available in 1957, and would provide 1,617,000 electrical hp, or 1,200,000 firm kw, at the Kitimat smelter after passing through the 49.6 miles of high-tension transmission line. That line involves some of the most interesting engineering features of the entire project. These will be outlined in a later section of this account.

Elements of the Project

The electrical-development phase of the scheme that will serve the aluminum smelter at Kitimat and such other industry as may locate in the area is thus made up of the following principal elements:

1, Kenney Dam and diversion tunnel
2, Power tunnel(s), 10.1 miles long to divert water from the catchment areas to the underground power station at Kemano
3, The Kemano underground power plant and its attendant works
4, Kemano-Kildala-Kitimat transmission line

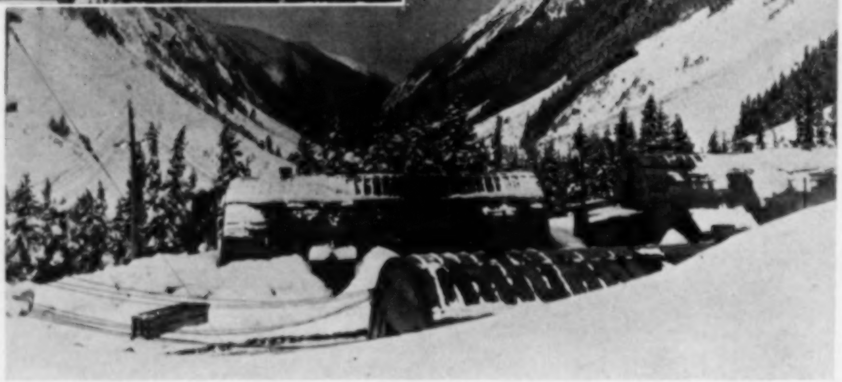
The magnitude of the undertaking and the vigor with which it is being prosecuted are partially indicated by the fact that the stationary and portable compressors distributed throughout the various working areas can deliver a total of 39,000 cfm of compressed air. (Editor's note: This represents roughly 7800 hp and exceeds by around 50 percent the air-power facilities that were available at Hoover Dam.) Air-powered rock-drilling equipment includes: ninety-five 3½-inch power-feed drifters, 95 Jackhamers, 30 stopers, 112 air-leg-mounted drills, 45 wagon drills, and some 15 diamond drills.

Still another forceful, though more general, indication of the size of the undertaking and what is being accomplished is the enormous capital outlay involved and the fact that but three short years will elapse between the start of the Kenney Dam diversion tunnel and the operation of the first three generators in the Kemano powerhouse.

Any consideration of the project in conjunction with its natural setting must lead to the conclusion that it could have been undertaken only on the scale adopted by the Aluminum Company of Canada and, further, to the realization that it was completely infeasible prior to the development of general construction equipment to its present level of utility, mobility, and efficiency. Interrelated with this, of course, is the added reflection that it is only the concomitant attributes of the highly developed technology of our civilization that creates an almost voracious demand for aluminum and other metals — and so our thoughts turn full circle.

Kenney Dam and Diversion Tunnel

The principal item of the impounding works is the Kenney Dam now underway in the Nechako River Canyon and scheduled for completion at the end of the present summer by the general contractors, Mannix Limited, of Calgary. This structure will rise 324 feet above bedrock and will be the largest rock-fill dam in Canada and exceeded elsewhere in the world only by San Gabriel, 380 feet, and Salt Springs, 328 feet, both of which are in California. This height allows a 7-foot flood surcharge above full



CAMP SITES

Camp builders followed closely behind the road hewers. By June of this year eighteen camps had been established and Morrison-Knudsen and its associates had 4500 men on the job. Here are winter views of Kemano (left) and Horetzky camps, which serve the powerhouse and main-tunnel areas of the work. In the top picture the cleared swath running up the mountain on the left marks the path of the aerial tramway and is also the line on which water will eventually descend in penstocks to the turbines of the underground powerhouse at the base of the slope.

reservoir level, with 13 feet of freeboard.

The load-carrying element is a heavy rock fill dumped with a downstream slope of 1:1.75 that will support on the upstream side a sloped impervious section of rolled-earth construction between suitable filter layers. This core will extend from a cutoff trench in sound rock to an elevation close to that of the top of the dam. Below the impervious core a grout curtain will provide effective cutoff. The mix will be forced into the upper 25 feet of rock at pressures of about 20 psi, and then at higher pressures to the necessary depth through holes drilled through the consolidated upper zone.

The crest width of the dam is to be 40 feet, and the slope of the upstream face, protected by quarry-run rock to resist wave erosion, will be 1:2.5 to insure a high safety factor. Freeboard at the abutments will be 13 feet, and a superelevation of 5 feet at the center of the 1550-foot crest length will allow for settlement. The longitudinal axis of the structure is being given a slight camber upstream, thus putting the core under axial compression and thereby lessening the possibility of tension stresses developing in the core.

Construction materials are being drawn from nearby quarries and borrow areas where suitable rock and impervious materials are readily available. The total volume required is expected to be in the order of 3,700,000 cubic yards.

Kenney Diversion Tunnel

Unwatering of the site of the Kenney Dam was effected by a diversion tunnel in the left bank that was completed late in 1951. It is of horseshoe section 32 feet in diameter and 1430 feet long. The invert elevation at the upstream end is 2529.5 and at the downstream end 2509.5 for a slope of 1.4 percent. The bore is provided with closure means at its upstream portal, and after it has served its present purpose is to be plugged with concrete beneath the impervious-core and grouted section of the dam proper.

Though Kitimat and Kemano are readily accessible by sea, the elements centered to the east of Horetzky Creek necessitated the building as quickly as possible of access routes suitable for handling large and heavy construction equipment. First-class roads of ample width and solidly bottomed had to be run across difficult terrain under conditions dictated by the timetable adopted for the project as a whole rather than by topography and seasonal ground conditions.

This eastern section of the area, which includes the camps located at the Kenney Dam and at the West Tahtsa intake works, is served by the Jasper-Prince Rupert Line of the Canadian National Railways through stations at Vanderhoof and Burns Lake. From Vanderhoof to the Kenney dam site a 60-mile road was constructed in the short span of three months in order that the diversion tunnel could be started on the tight schedule allowed; that is, in the spring of 1951.

From Burns Lake a provincial government road extended 50 miles in a general southwesterly direction to Tahtsa Lake and Ootsa Lake. Much of this existing mileage was rebuilt, while a stretch of 54 miles to the eastern end of Tahtsa Lake is new construction. The 20 miles from this point to the tunnel intake works at the west end of the lake is served by two 40-ton steel barges. They were built in Vancouver in five sections, shipped to Burns Lake by rail, hauled over the roads and reassembled, one on the shore of Tahtsa Lake and the other at Ootsa Lake. The latter vessel virtually pulled its way up the Tahtsa River by means of a tractor mounted near its bow, and both craft now regularly ply the length of Tahtsa Lake.

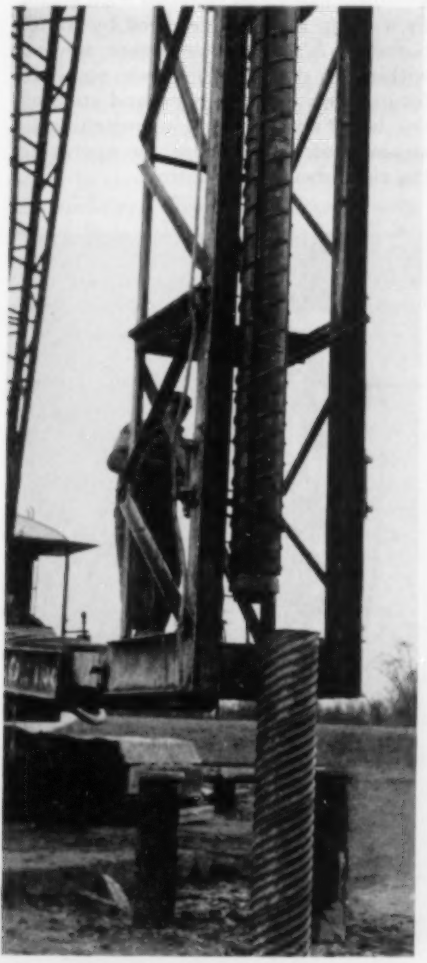
(To be continued)

Air-expanded Mandrel Stiffens Long Piles

Data and Illustrations from *Construction Methods*

THIN-WALLED pile shells more than 100 feet long were made stiff enough for driving into the ground by inserting in them a segmental mandrel and expanding it with compressed air. Using this unusual technique, the C. L. Guild Construction Company, Inc., East Providence, R.I., drove 155 of the steel tubes, which were then filled with concrete to support two digestion tanks at the East Hartford, Conn., sewage treatment plant.

Each shell was made of a 103-foot length of 16-gauge corrugated (Armco-Hel-Cor) metal and has a heavier pipe 30 feet long at the tip. To support the 12-inch diameter thin-walled section during driving, each was gripped internally by the mandrel, an 8-ton, 105-foot, steel-and-rubber unit that was distended by means of compressed air. While so held, it was hammered through 25 to 30 feet of earth fill, 95 to 100 feet of wet sand and silt, and brought to bear in a layer of gravel.



MANDREL AND PILE

The mandrel, at the top, has been collapsed by releasing the compressed air and allowing it to escape from its inner tube. The mandrel is 105 feet long and weighs 8 tons. It was made of two units 45 and 60 feet long that were coupled together.

IN THE "DOODLE HOLE"

The long, limber shell, left, was lifted by crane and then lowered into a 16-inch cased hole 100 feet deep. There it rested while the mandrel was inserted in it (above). All the piles were thus lowered in the one "doodle hole."

The mandrel was developed by Walter Cobi, a partner in the Pneumatic Pile Company of New York, and consists of four sector-shaped steel members each made up of longitudinal structural angles with an arc-shaped plate forming a quarter circle between angle toes. Helical, half-round bars are welded to the arc plates every 18 inches to fit the corrugations of the shell when the mandrel is expanded.

Extending lengthwise through the mandrel is a circular rubber tube to which the air—the expansion medium—is admitted. This tube is inside another rubber envelope that is square in section and the corners of which fit between adjacent sectors of the mandrel. The latter tube is reinforced with a nylon fabric that permits it to change shape but not to expand.

Air at a pressure of 125 psi was used to inflate the inner tube which, in turn, forced the steel sectors of the mandrel outward so that they gripped the shell tight throughout its entire length. Maximum possible expansion was 1½ inches. With the entire pile in position, collapse of the mandrel was achieved by releasing the air in the core tube and the tension on 300-pound coil springs spaced at 15-

JOINING SHELL SECTIONS

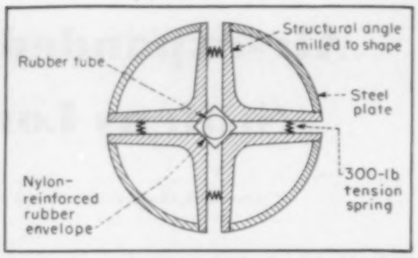
Resting on wooden rollers to facilitate turning, the 12-inch-diameter shell sections were gas-welded into 103-foot lengths for driving.

foot intervals between adjacent sectors. In that condition, the diameter of the mandrel was ¾ inch less than that of the surrounding shell.

In view of the fact that unequal ground pressure at the extreme depth to which the 133-foot pipes were to be driven might cause an empty 16-gauge shell (the heaviest now rolled) to crumple, the bottom 30 feet of each was made of Armco spiral-welded pipe 10¾ inches in diameter and ¼ inch in thickness. It was closed at the bottom by a ¾-inch plate. This tip was fastened to the shell by a cast-steel transition sleeve. The upper part of the latter was corrugated to fit the shell, to which it was welded, while the inner surface of the lower end was milled for a driving fit over the heavier pipe. An inner circular lip at the point where the two sections came together served as a shelf on which the mandrel rested during pile driving.

Assembly and driving proceeded as follows: Usually, from 10 to 20 of the 30-foot tips were spotted and hammered almost to ground level before the corrugated shells were attached. To facilitate handling the unwieldy mandrel and the 103-foot pipe lengths, a 16-inch casing was driven into the ground to a depth of 100 feet. Called a "doodle hole," it was fairly centrally located in relation to the working area so that it could be used for all the 155 piles involved in the $97,000 contract with the least change in the pile driver's position.

After a shell was lowered into the hole by the rig, the latter inserted the mandrel into the shell. But before the assembly was hoisted into the 130-foot leads of the hammer and placed atop of the tips already in the ground the mandrel was expanded. Next, the transition sleeve was welded to the shell to insure watertightness and, with that done, the pipe was ready to be driven. When it reached the required bearing in gravel some 125 feet below the surface, the mandrel was collapsed and lifted clear. The work proceeded at an average rate of one pile an hour. After inspection, the pipes were filled with concrete. Although they were designed to support a load of 40 tons, those tested under 60 tons by jacking the pile driver on top of them showed a net settlement of only $3/16$ inch.


Structural angle milled to shape
Rubber tube
Steel plate
300-lb tension spring
Nylon-reinforced rubber envelope

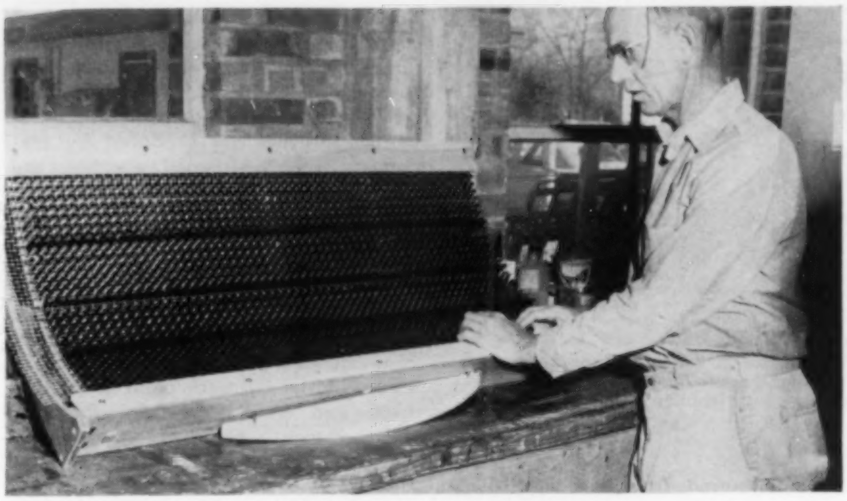
MANDREL CROSS SECTION

Although schematic only, the sketch shows the segmental construction and reveals how the unit was expanded by filling the central rubber tube with compressed air.

A Vulcan No. 1 hammer on a Lima 802 crane was used to drive the piles. It was powered by a 125-hp Waukesha gasoline engine and supplied with steam by a 50-hp Dillon boiler fired by Aeroil burners. A 40-cfm compressor, housed within the cab, furnished air not only for expanding the mandrel and starting the boiler's burners before switching to steam injection but also for operating the rig's pneumatic controls.

PILE DRIVING

The leads on the pile-driving rig on the Lima crane were 130 feet high. An oil-fired boiler supplied steam for operating the Vulcan No. 1 hammer, and a compressor, carried on the crane to operate its pneumatically valved controls, furnished air at 125 psi pressure for expanding the mandrel. The piles were driven at the rate of one per hour.

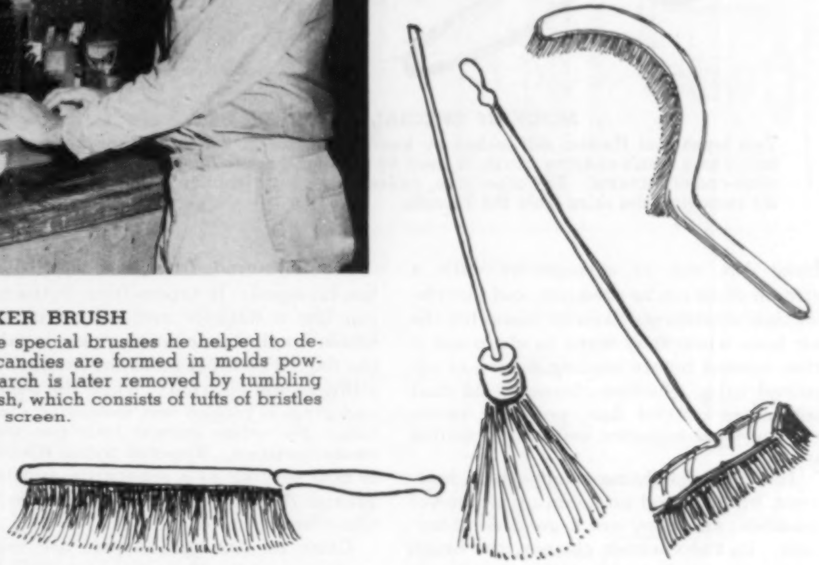


STARCH-SIEVE SHAKER BRUSH

Lee Roy Haisler is shown here with one of the special brushes he helped to develop for the candymaking industry. Some candies are formed in molds powdered with starch to prevent sticking. The starch is later removed by tumbling the pieces across the curved surface of the brush, which consists of tufts of bristles extending up through the openings of a metal screen.

OLD-TIME BRUSHES

The author copied these sketches from an account of brushes that appeared in a book published around Civil War times. From left to right they show brushes for dusting store counters, home dusting, sweeping floors, and removing crumbs from the dining table. Some of these have modern counterparts.



Hand-Made Brushes

Fremont Kutnewsky

BRUSHMAKING began one prehistoric day when a cave woman tied together a bundle of twigs and swept aside the trash that littered the simple shelter where the family ate and slept. In thus extending the efficiency of her hands and fingers she unconsciously helped to lay the foundation for all industry.

Down through the ages, brushes marched along with human progress — they were used to paint hieroglyphics on the sides of cliffs, murals in palaces, miniatures, landscapes, to do fresco painting, for personal grooming, for cleaning and decorating homes, and, finally, for industrial purposes. In ancient Greece, they were frequently given as prizes, and fairly good ones 1500 years old have been found in the ruins of Pompeii. Today they are fundamentally what they've always been—a bundle of fibers, plant stalks, bristles, hairs, feathers or wire tied together and fastened to a back or handle.

New applications for brushes have been discovered just as fast as man has conceived more things to do than his two hands, implements and machinery could perform. For domestic as well as industrial purposes, the brush is probably civilization's most universally used tool. As many as 30 different kinds have daily jobs to do in the modern household, barbershops require from eight to ten, and most industries have at least one but often many designed for specific needs.

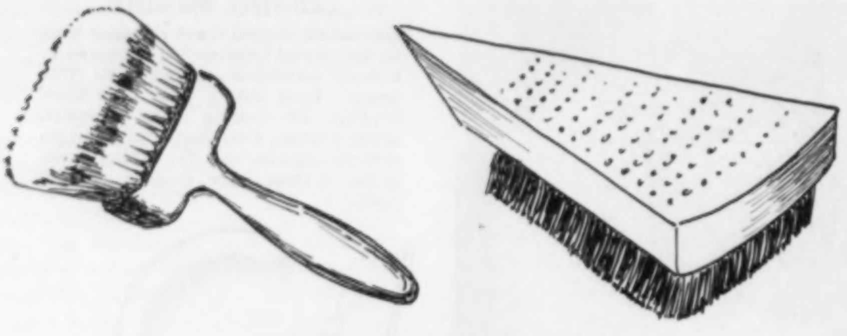
Up to 1910 or so all brushes were made by hand and were comparatively expensive. Bristles were always scarce, and the international fiber trade wasn't fully developed. But when machinery got into the game, aided and abetted by Fuller-the-brushman, costs were soon cut to where people could afford to own them by the dozen. About 98 percent of all brushes are now produced by machine; the remaining 2 percent are the work of small but independent concerns that supply brushes of special design and high quality—a business in which price is not of primary consideration.

The craftsmen of the old school who make the odd-size specialty brushes industry demands are few in number and, for the moment at least, are in a key position. That's why Haisler Bros. Company, old-line manufacturer of hand-made brushes, was able to move its small factory from Chicago to Albuquerque, N. Mex., without upsetting its relations with a single customer. When Lee Roy and Edwin H. Haisler decided to go West in 1947 they just looked around and picked a spot where they thought they would like to live. They didn't worry too much about being farther away from their markets. The firm, established by their father in 1894, had customers who, they felt, would keep on buying their wares. Their hunch was right; instead of losing orders their volume of sales jumped about 20 percent.

Users of Haisler products include 75 large candy manufacturers and several hundred other industrial concerns that want brushes guaranteed not to shed a hair or crack a back under the most trying conditions. Candymakers require twelve kinds, and the inadvertent distribution of a few whiskered bonbons might be enough to cancel the effect of thousands of dollars worth of good-will advertising. Brewers need large, curved fiber brushes to scour their vats and barrels, and meat packers have found brushes most suitable for cleaning hog sides quickly and reaming out sausage casings.

The company makes fourteen brushes for printers, engravers and stereotypers. There, too, a stray hair, even a speck of dust, might play hob with operations, for it could ruin a beautiful reproduction. Some of the brushes used in the graphic arts have to stand up under immersion in benzene, lye and acids. There are different types for blanching peanuts, for big street sweepers, for bottle washing, for paper and textile mills, tobacco factories, stone quarries, smelters and refineries. Then, too, the concern is more than a producer of brushes. It is prepared to design and manufacture new kinds for specific purposes and to repair, refill and rebuild old ones.

About the only competitor the brush ever runs up against even in this enterprising age is air, which does many jobs faster and better. Garage mechanics



MODERN SPECIALTY BRUSHES

Two types that Haisler still makes by hand. The one at the left, of soft badger hair like a man's shaving brush, is used by candymakers to give a sheen to chocolate-coated creams. The other one, called a peanut blancher, has stiff bristles for removing the skins from the kernels.

force dirt out of carburetors with a stream of air under pressure, and service-station attendants likewise reach for the air hose when they want to clean out a tire carcass before seating a new or repaired tube. Suction cleaners and dust inhibitors control fine, powdery materials in large bakeries and rock-crushing plants.

Instead of fighting each other, however, brushes and air team up whenever possible, and they are a good combination. In the vacuum cleaner, the brush picks up the dirt and suction whisks it into the bag. In automatic packaging, the brush serves as fingers and the air as motive power. One of the simplest examples in the latter field is the wrapping of chocolate creams in tinfoil by means of a brush and a little suction. Haisler makes such a brush. It is circular, and its bristles all point toward the center, leaving a soft, "brushy" pathway in the middle The piece of candy is dropped on the foil on top of the brush, the air sucks both down through the opening, and the flagged ends of the bristles gently and accurately fold the wrapping around the chocolate drop.

The air brush that sprays pigment on work with soft, cloudy effects has been a boon to commercial artists and show-card men Similar air-operated guns are used to lacquer automobiles and furniture, to cover walls with cement and plaster, as well as to coat materials with plastic emulsions. For these particular purposes, and others yet to come no doubt, compressed air is better suited than a brush and works faster.

Bristles and fibers have presented a problem ever since brushmaking began in this country more than a hundred years ago. Hairs of the marten, sable, squirrel, badger, skunk, goat, pig, boar, horse, ox and bear are mostly used, though synthetic filaments such as nylon have recently made big inroads in the field. In a good many brushes two or more kinds of bristles are blended. The Haisler brothers dislike straight nylon but they often combine it with natural bristles for different purposes.

For high-grade brushes the pig bristle has no equal. It tapers from bottom to top like a flagpole and the small end, which is split like a writing pen, is called the flag. The taper gives the bristle both stiffness and elasticity, while the flagged end gives it pickup and spreading qualities. No other animal hair has these characteristics. Tapered nylon filament is now serving as a substitute and is in greater demand than pig bristles in the toilet-brush industry.

Close to 100 million pigs are raised each year in the United States, but they are slaughtered too young to furnish material of the desired length. For bristles 3 inches or longer the trade depends on the small farmer of China, Russia, Germany, France and other countries. The United States purchases about 75 percent of the Chinese supply, usually around five million pounds annually. Because of defense needs, the importation of hog bristles from Europe and China has been under government license since December, 1950, but last year restrictions were eased partly on account of nylon.

Prior to 1900 this country obtained the bulk of its high-grade bristles from Russia. Later we turned to China, where wild strains of pigs provide the long bristles so much in demand for fine varnishing and finishing brushes. But Chinamen eat pork like we do, and they do not let a sufficient number of their pigs grow to the proper age. Supplies are decreasing year by year. Preparing bristles for world markets is a tedious task, for which American workmen are not temperamentally equipped. China hog bristles, for instance, come in black and white and are sorted and separated as to color by hand. With five million pounds exported annually, that adds up to a lot of labor

Hand-made brushes are usually either set or drawn. For the set type the material is knotted, dipped in resin cement, bound on one end with thread, dipped again and inserted into a hole in the back. In the case of the hand-drawn brush, tufts of material are pulled into the holes by wire loops. By this method the bristle is doubled and caught in the middle so that both ends project from the back of the brush. Twisted-in-wire, rolled-in-metal (steel-gripped), and trepanned brushes are produced by machines. In the last-named type, holes are bored to a certain depth in the back to connect with a transverse hole, through which the binder or thread ties onto the tufts.

Tough brushes, the scrubbing kind, are manufactured of vegetable fibers. Haisler uses the finest obtainable. They come mostly from the roots, trunk or leaves of the Palmyra palm of tropical India and West Africa; the Palmetto palm of South Carolina, Georgia and Florida; rice roots from Mexico; and the Agave, a type of century plant, that grows in Mexico, Texas, New Mexico and Southern California.

In view of industry's special needs, the hand-made brush business would still seem to be on fairly solid ground. However, machines are continually being improved, and the time is no doubt approaching when mass-production methods will eat still further into the field of the hand craftsman. Fully automatic brushmaking machinery is only about 30 years old. Lee Roy Haisler says that it is hard to find an experienced brushmaker today under 30, for when the machines were introduced the industry stopped training men. Those employed by him learned their trade in Europe many years ago.

There are probably 30 small manufacturers in the United States like Haisler Bros. Company that produce brushes by hand exclusively, and altogether they employ no more than 300 craftsmen. Meantime, good brushmakers are in demand and can, if they want to, set up for themselves. This might be a tip for organizations concerned with finding occupational opportunities for physically handicapped persons.

BRUSHMAKER AT WORK

A skilled veteran inserting tufts in a long machine brush in the Haisler Bros. Company factory.

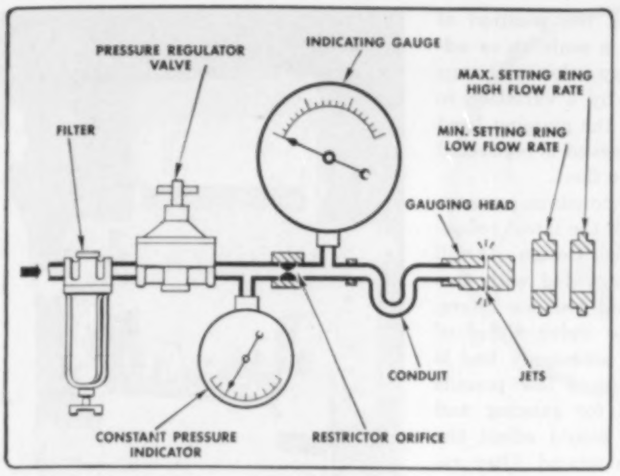

PRESSURE REGULATOR VALVE
INDICATING GAUGE
MAX. SETTING RING HIGH FLOW RATE
FILTER
MIN. SETTING RING LOW FLOW RATE
GAUGING HEAD
CONDUIT
JETS
CONSTANT PRESSURE INDICATOR
RESTRICTOR ORIFICE

FIGURE 1

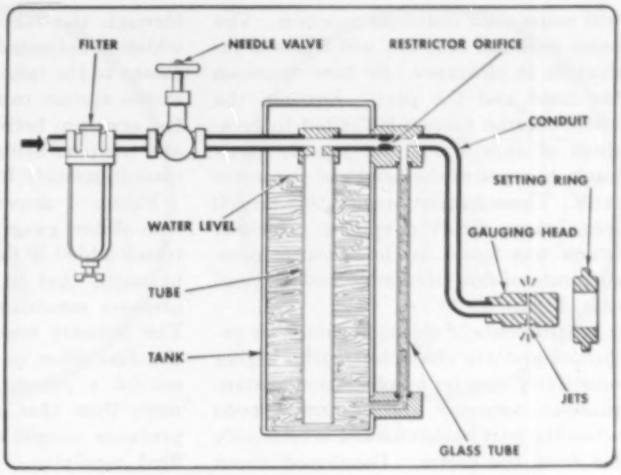

FILTER
NEEDLE VALVE
RESTRICTOR ORIFICE
CONDUIT
SETTING RING
WATER LEVEL
GAUGING HEAD
TUBE
TANK
JETS
GLASS TUBE

FIGURE 2

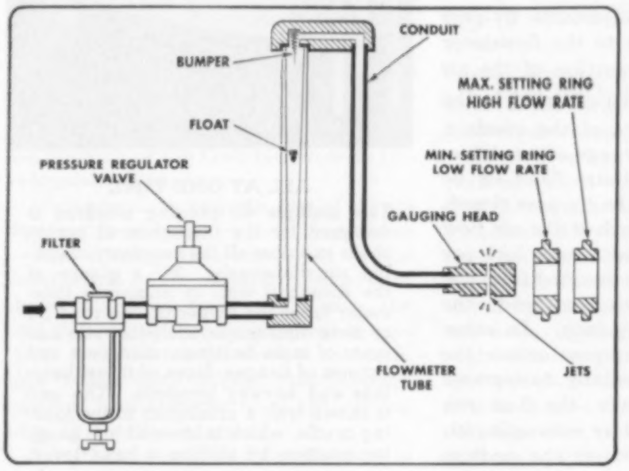

CONDUIT
BUMPER
MAX. SETTING RING HIGH FLOW RATE
FLOAT
PRESSURE REGULATOR VALVE
MIN. SETTING RING LOW FLOW RATE
GAUGING HEAD
FILTER
FLOWMETER TUBE
JETS

FIGURE 3

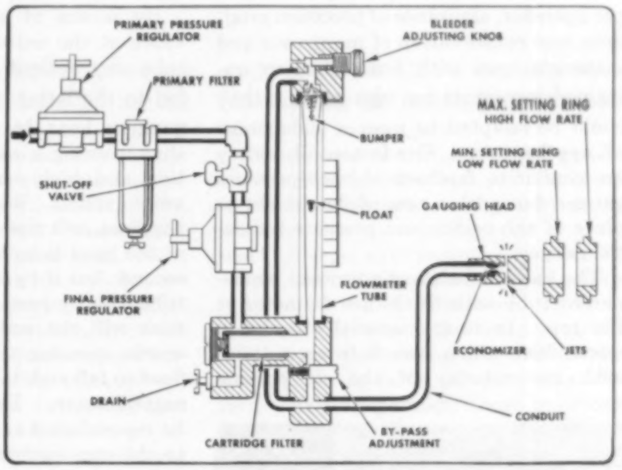

PRIMARY PRESSURE REGULATOR
BLEEDER ADJUSTING KNOB
PRIMARY FILTER
MAX. SETTING RING HIGH FLOW RATE
BUMPER
MIN. SETTING RING LOW FLOW RATE
SHUT-OFF VALVE
FLOAT
GAUGING HEAD
FINAL PRESSURE REGULATOR
FLOWMETER TUBE
ECONOMIZER
JETS
DRAIN
CONDUIT
CARTRIDGE FILTER
BY-PASS ADJUSTMENT

FIGURE 4

Modern Air Gauging

Instruments Insure Dimensional Control to Millionths of an Inch

J. C. Pierce

EARLY in the last decade tool engineers came face to face with the fact that there was need of gauging devices that could be counted upon to perform industry's thousands of internal and external close-tolerance machining and gauging operations quickly and with precision. Under the pressures of World War II, processing mistakes led to intolerable waste of materials because inferior parts were getting past inspectors while good ones were often scrapped. Adding to the manufacturer's dilemma at that time, when high output was mandatory, were high labor costs and a scarcity of skilled workers. Hence, industry began to cast about for control and inspection equipment that did not require trained operators and that combined adaptability with speed of performance and accuracy.

The answer to the problem came with the development of air gauging wherein measurement depends upon metering air velocities rather than air pressures, as do the older, familiar back-pressure gauges. However, whether metering velocities or pressures, the operation of all these instruments depends, essentially, upon a flow of air between the faces of jets, or specially constructed heads, and the part being checked.

The mechanical back-pressure type normally consists of a filter in the air-supply line to remove all moisture and foreign matter from the air, a pressure-regulator valve to deliver air at constant pressure, a restrictor orifice and a gauging head, as shown in Figure 1. The pressure recorded on the indicator dial is a product of the upset balance of the flow between the orifice and the head when gauging an element. When the system is properly balanced and calibrated for a given application, tolerance values are read directly from the dial.

The water-column gauge, Figure 2, is based on the same principle but uses a vertical tank of water containing a submerged open-bottomed tube as a regulator to maintain constant pressure. Enough air is introduced in the upper end of the tube by means of a needle valve to displace the water, thereby maintaining constant pressure that can be changed only by changing the level of the water in the tank. A vertical, calibrated glass tube, which connects the bottom of the tank with a conduit extending between the restrictor orifice and the gauging head, indicates the height of the water in the tank. When the instrument is in use, back pressure from the head lowers the water level in the calibrated tube proportionately, and the point where it comes to rest is the gauging value.

Back-pressure gauges must be close to the head, otherwise the volume of the conduit will increase to an extent that will cause slow indicator reaction. The same retarded reaction will follow a reduction in clearance (air flow) between the head and the part. Further, the water-column system is limited to pressures of only about one pound, maximum, because of the height of the water tank. These restrictions led to a search for a more direct operating principle, which was found in the constant-pressure rate-of-flow air gauge now so popular, Figure 3.

Instruments of this type meter air velocities and are characterized by higher sensitivity, greater amplification, instantaneous response and accuracy even when the part being checked is relatively far from the meter. Developed about 1940, they were quickly adopted by industry as production-line accessories not only because they meant higher output per operator, assurance of precision products, and conservation of manpower and materials even with semiskilled or untrained inspectors but also because they could be adapted to meet a wide range of applications. Fundamentally, they are similar to mechanical back-pressure gauges, but with a rate-of-flow meter in place of the orifice and pressure-indicator gauge.

The meter consists of a tapered, transparent tube with the larger diameter at the top. In it is a specially designed metal float which travels in accordance with the velocity of the air passing through the tube and the position of which is indicated by a scale on or adjacent to the tube. Any velocity change in the system caused by a variation in the aperture between the gauging head and the part being checked is registered instantaneously by the float.

CHECKING INSIDE DIAMETERS

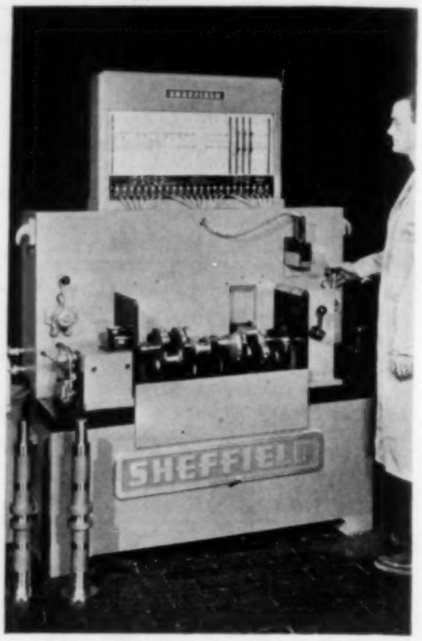
Air-operated tools are built to close tolerances. Here a machinist is checking the bore of an Ingersoll-Rand tie-tamper barrel after honing it on the machine in the background. He hones and measures until the constant-pressure, rate-of-flow air gauge in front of him tells him that the inside diameter is exactly as specified. The column-type Precisionaire takes all the guesswork out of the work. Note the float between the black tolerance-limit markers alongside the flowmeter tube.

Figure 4 shows a constant-pressure rate-of-flow gauge with the latest refinements added to the basic design. It will be noted that it is provided with two pressure regulators and two air filters. The primary regulator valve ahead of the first filter in the air-supply line is set for a pressure only a few pounds more than that used for gauging and prevents surges that would affect the final regulator. The second filter removes any condensate missed by the primary separator as well as that resulting from the final pressure drop.

By means of an adjustable by-pass valve at the entrance to the flowmeter tube any desired proportion of the air fed to the latter can be diverted to the gauging head by way of the conduit, thus insuring a wide range of amplification and high sensitivity. Let us be more explicit. With the by-pass closed, the float will rise 1 inch if the air flow at the head is increased 1 cubic inch per second; but if ½ cis is diverted from the tube—is by-passed to the head—the float will rise only ½ inch. In other words, opening the by-pass causes the float to fall and, incidentally, to decrease amplification. However, the float can be repositioned at will by exhausting air to the atmosphere through the medium of an adjustable bleeder at the top of the tube. Another feature of the instrument is an orifice of predetermined size placed as close as possible to the jets in the head. It is called an economizer because it effects considerable savings in air by permitting the passage only of the maximum flow required for metering parts, plus a small amount as a margin of safety.

Gauges of the improved constant-pressure, rate-of-flow type have a long service life because they have few parts that need maintenance or replacement. Even the heads, with their varied air-snaps for external measurement and spindles for internal gauging, are subjected to little wear. Too, appreciable wear is tolerated at these points by reason of the fact that the instruments can be checked periodically against master controls and the flowmeter floats adjusted accordingly to give accurate comparative readings.

The automobile industry, with its advanced production-line methods, was perhaps the first to fully appreciate the value of air gauges. It has led all others in putting them to use, expecially in the form of comparators built into machine tools for automatic sizing during metal removal. For this work, as well as for inspection, they are indispensable.



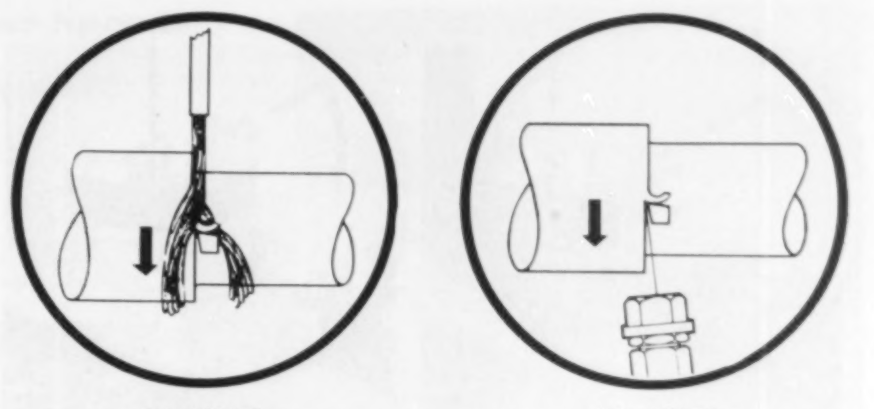
ALL AT ONE TIME

This multiple air-gauging machine is designed for the inspection of crankshafts and does all the necessary checking simultaneously. By a glance at the Airechart with its numerous flowmeter tubes the inspector can read 34 or more dimensions, including size and taper of main bearings, diameters and runouts of flanges, faces of thrust bearings and keyway locations. The unit is shown with a crankshaft in the loading cradle, which is lowered into gauging position by shifting a hand lever.

The car manufacturer has learned that inspectors, no matter how experienced, will suffer from fatigue on repetitive operations as the day goes on and are liable to become inefficient in consequence. One instrument now gauges 2800 piston pins an hour—performing six operations with like precision. Another replaces eight inspectors by measuring 800 pistons an hour. They are also used to check crankshaft bearing bores, main bearing journals, connecting rods, camshafts, valve rocker arms, etc.

Of all the elements that require accurate dimensional control about 42 percent involve taking internal measurements for which there were no, or only makeshift, means available prior to air gauging. Whereas the ordinary blind hole formerly presented a serious inspection problem, it can now be completely analyzed as to depth of taper, roundness, bellmouth, scratches and size. Tolerances to millionths of an inch, simply out of the question previously, are today regularly specified for many internal and external machining operations. In the case of some fits, a variation of only ten, even five, millionths of an inch is permissible, and flow-type air gauges used in connection with machines are making them consistently.

Jets of Oil Speed Metal Cutting



OLD METHOD

NEW METHOD

HITTING THE SPOT

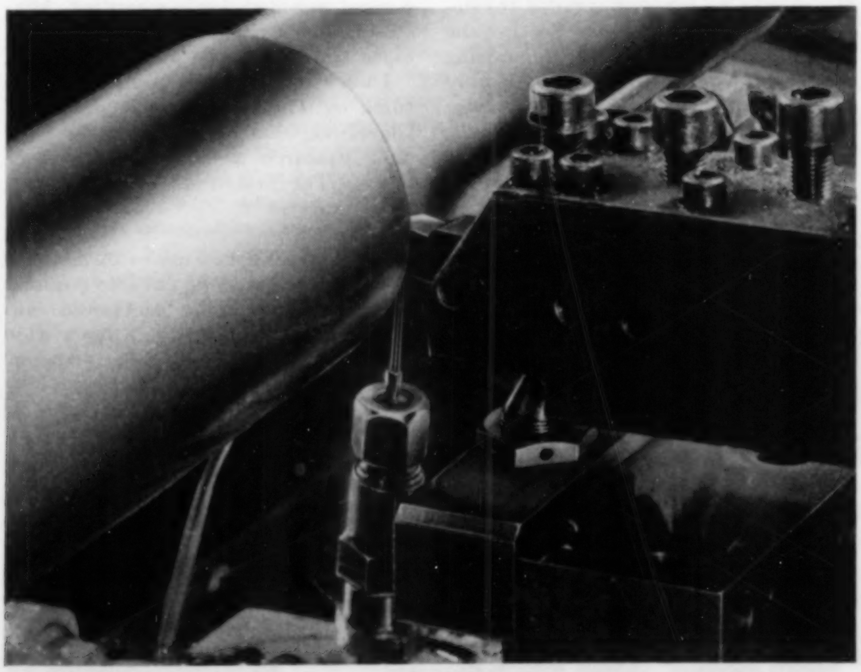
The sketches show the main advantage of jetting oil from below. Note how the overhanging chip, left, prevents oil that is flowed onto the work from reaching the cutting edge of the tool.

THE nation's metal-machining capacity may be nearly doubled and cutting-tool life increased from three to twelve times by a new method of cooling and lubrication, according to Gulf Oil Corporation, its originator. Called Hi-Jet, the system differs radically from the conventional one of flooding the tool with oil from overhead. It was invented by R. J. S. Pigott, director of engineering research of the Gulf Research & Development Company.

High-speed thread-like jets of oil are directed from below — not from above — the cutting tool, impinging at the point where its tip comes in contact with the work. Now, for the first time, the tool is being efficiently lubricated, says Gulf. Because the oil reaches the exact spot where heat is generated through friction, heat transfer from the cutting edge is greatly improved.

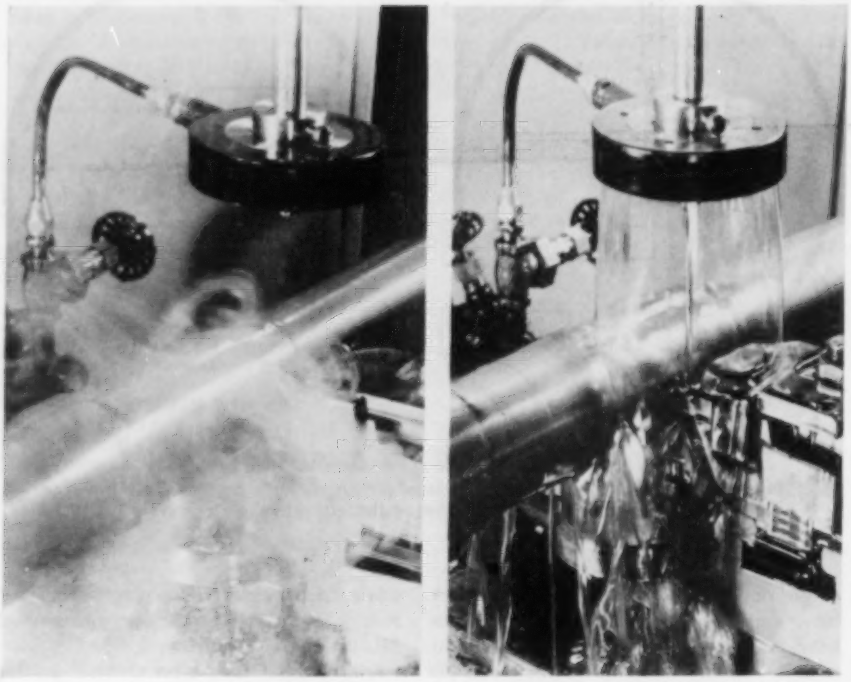
For many years cutting oils used in single-point tool machining operations have acted more as coolants than as lubricants when applied by conventional means. Even as coolants they cannot perform effectively for the same reason that they cannot lubricate satisfactorily, for seldom does a sufficient volume reach the area where heat is produced. Thus, their main function has been to extract the heat conducted through the chip, the work, or the exposed shank of the tool. Examination of a machined surface as left by the cutting edge reveals it to be bright and dry, indicating that the edge has received little or no lubricant in spite of the flood of oil over work and tool. This is not surprising, remembering that cutting pressures reach 50,000 psi and higher.

The answer to the problem of getting the oil between the tool and the work is Hi-Jet. Because of slight irregularities in both the cutting edge and the work surface, tiny passages are formed. When the high-speed streams of oil are applied to the underside of the tool's cutting edge where the temperature is well above the boiling point of the lubricant, the liquid is vaporized and thus forces its way through these openings. In the process of vaporization, the oil picks up considerable heat from the most critical area—the cutting edge. After passing the latter, the vapor condenses on the cooler chip and tool shank and gives off the heat picked up at the cutting edge. Proof that the oil actually passes the cutting edge and is caught between the work and tool is found in the fact that the chips that leave the contact area are coated with oil, tool build-up is eliminated (chips are not welded to the cutting edge by the heat generated), nose wear is reduced, and the chip crater is more uniform.



THE JET SYSTEM

The "Hi-Jet" setup, left, shows three tiny streams of oil being directed from below under pressure great enough to reach the point where cutting is being done. The assembly (right) consists essentially of a 1-hp motor-driven gear pump and of flexible tubing to carry the oil to the nozzle under 400 psi pressure.



PROTECTIVE CURTAIN

Smoke created by vaporization of the oil (left) gives evidence that the latter is reaching the cutting edge of the tool where high temperature prevails. To quench the smoke it is enveloped by a cylindrical curtain of oil directed from shower heads above and below the working location. The curtain also prevents the cutting oil from spattering when the tool is not in contact with the work.

Hi-Jet offers a number of advantages over the overhead flood method which has been in use for more than 50 years. The most important of these are longer tool life and greater cutting rates, which are especially marked in the case of high-speed tool steels. At normal cutting speeds, the life of tools of the latter type has been increased six to twelve times, it is reported; at low speeds cutting rates have been doubled without any sacrifice in tool life. When Hi-Jet is applied to carbide tools their life is lengthened from three to five times. As a result, setup and grinding time can often be considerably reduced. This means that fewer tools are needed and, on large production jobs, indicates substantial savings in tool inventory and cost. It seems certain that all these improvements, made possible by the Hi-Jet method, will greatly increase the demand for high-speed tool steels, thus lessening the need of draining the nation's supply of scarce sintered-carbide tools.

Work machined with Hi-Jet is superior in surface finish and dimensional accuracy because of the more effective cooling and lubricating action on the tool radius. In consequence, there is less need of additional finishing operations and, in some instances, they can be dispensed with altogether. Grinding time, too, can often be shortened because of smaller dimensional variations. Further, there is less tendency towards work-hardening of the machined parts. On some jobs this may mean a reduction in stresses that cause distortion and surface hardening.

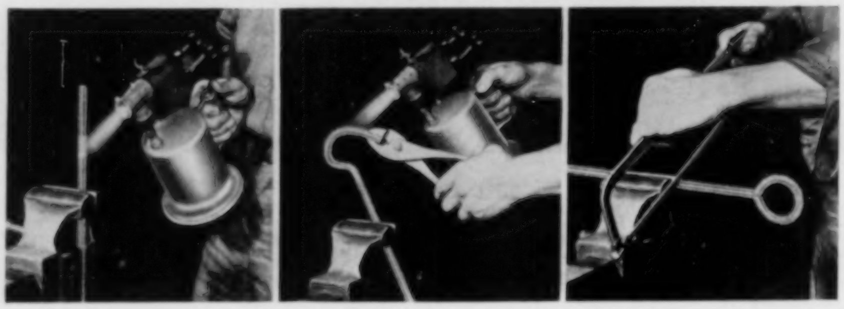
For its Hi-Jet system Gulf has prepared a special oil after testing in excess of 50 kinds, which included more than fifteen existing oils and entailed the development of 35 new ones. Because the new lubricant gets between the cutting tool and the work surface, considerably more heat is carried away than under ordinary circumstances and, as a result, much more smoke and vapor are generated. Therefore, a special coolant spray is furnished and connected to the present overhead flood system. It serves the dual purpose of providing a cylindrical curtain of oil which smothers the smoke and vapor and of catching the stream of oil when the tool is not in contact with the work, thus preventing splattering.

At first the Hi-Jet system will find its widest application in turning operations because the nozzle in its present form has been designed primarily for lathes and vertical boring mills. However, different types of nozzles and attaching fixtures will make it possible to use the method on many other machining jobs. Good results can be obtained with most turning operations, but the greatest savings will be made on high-production work where tool life is abnormally short. Hi-Jet is also practicable where tool setup time is high in relation to operating time on the machine, or where the number of tool changes is excessive.

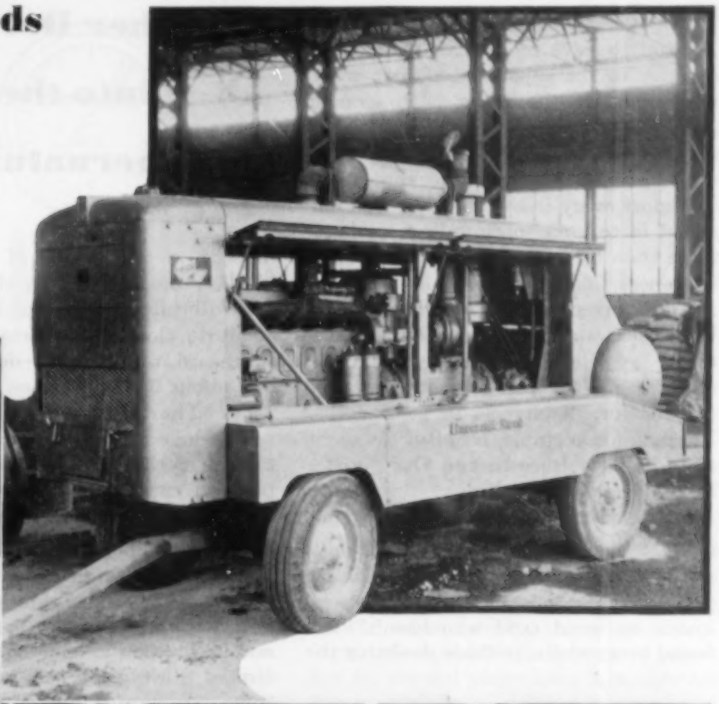
The component parts of the unit are a motor-driven 1-hp gear pump, filters, a pressure-regulating valve, flexible hose, a jet nozzle and holder, and the low-pressure coolant spray. The pump discharge is kept at 400 psi. On many machines the Hi-Jet system can be installed in a matter of hours, although some engineering skill is required. To reduce the possibility of chip interference, the nozzle is mounted no farther than 2 or 3 inches from the cutting edge of the tool and the stream of oil is always aimed so that it comes in contact with the cutting edge. This is the most important consideration in mounting. Misdirection will mean loss of the advantages inherent in the method.

Hi-Jet equipment is being manufactured by Thompson Products, Inc., of Cleveland, Ohio, under licenses from the Gulf Research & Development Company. The first units were delivered this summer.

The accompanying pictures show an adaptable threaded metal rod recently put on the market by Redi-Bolt (also the name of the product) for use on the job. The stock is 36 inches long, made of cold-drawn steel, precision threaded from end to end, takes standard nuts, and is protected against rust by a special coating. It can be readily bent with pliers after heating to form U, L, Eye or other bolts and cut into required lengths, or it can be hacksawed into straight bolts or tierods, all for a wide range of applications including repair, installation and structural work. The rods come in six diameters from ¼ to ¾ inch and are being distributed through hardware stores, mill supply houses, etc.

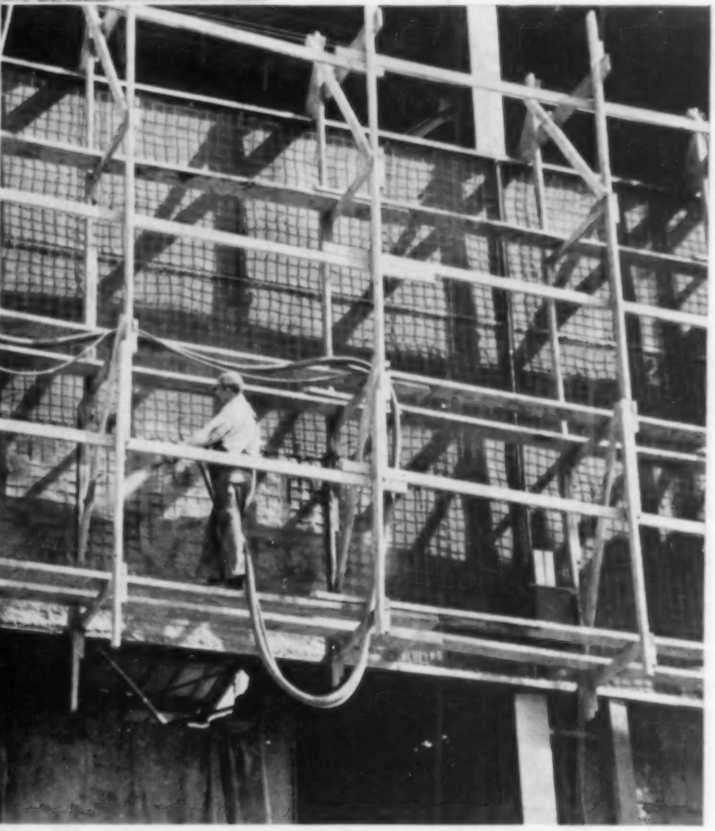


Rotary Compressor Speeds 'Gunite' Application



THE COMPRESSOR

Right: Stationed on the ground floor, the machine supplied air for a 67,000-square-foot wall job of "Guniting" that was carried on at a rate of 200 square feet per hour.



MIXING AND PLACING

One of the two Cement Guns, upper-left, in which sand and cement were mixed by an air-operated device. From the units the dry mix was air-borne through hoses to the points of placement. Water was added at the nozzles. The concrete was blown on forms (above) to a thickness of 2 inches.

RECORDS compiled by a Detroit firm of contractors indicate that when air is supplied by a newly developed 600-cfm rotary-type portable compressor, "Gunite" can be applied to walls and other surfaces 25 percent faster than when the air comes from a conventional reciprocating-type machine of 500-cfm capacity. The concern, Hanna, Zabriskie & Daron, has specialized since 1922 in pneumatically applying the concrete mix known as "Gunite" and owns thirteen Cement Gun Company (Allentown Pa.,) outfits by which the work is done.

In August, 1951, it bought a Gyro-Flo 600-cfm compressor that had been introduced a few months before by Ingersoll-Rand Company. Although of greater capacity, this unit is considerably smaller than a 500-cfm reciprocating portable. The former is driven at 1800 rpm by a General Motors 6-cylinder diesel engine, the availability of which was a vital factor in the machine's development.

The rotary compressor under discussion furnishes air for two "Cement Guns," and the records, which extend over a period of eight months, have consistently reflected the substantial increase in productiveness mentioned in the first paragraph. Harvey Hanna, president of the contracting firm, states that approximately 120 cfm of air is required to operate the mechanisms that mix the dry cement and sand. This leaves 480 cfm for conveying the mixture through hoses to the points of application, or 240 cfm for each gun. On a recent job that involved "shooting" 67,000 square feet of 2-inch wall on a high industrial building, progress was maintained at the rate of 100 square feet per gun per hour.

Further Delving into the Supernatural

PEOPLE living in isolated places are said to have more than their share of faith in the supernatural, but truly widespread is the belief that strange powers repose in certain unearthly beings — playful or sinister. Acceptance of things eerie of course takes some form in almost every individual, but men engaged in toilsome occupations, perhaps more than others, are receptive to such influences, finding in them a little needed zest and diversion. So Peruvian miners have their *muquis,* and others have uncanny favorites personified by conniving elves or goblins and given to mirth or mischief or, perchance, to good deeds. Loggers, for example, boast of the great feats of Paul Bunyan and Ole the Big Swede.

We scoff at others' superstitions but cling to our own to the end of our days with an attitude at times of — Don't you say mine is a fake! Those who knock on wood (and who hasn't?) are found everywhere, perhaps doubting the efficacy of it but taking no chances. Fishermen spit on the bait, whether it be in California, Minnesota or New Jersey. It is well agreed that an itching nose means that company is about to arrive. One need not mention the ill-luck black cats, umbrellas, Friday, or the hoodoo that is associated with thirteen, which is deemed so ominous that nowhere from coast to coast would one be offered a hotel room bearing that number. Picking up a penny is good luck, but to pick up a piece of iron is bad luck, unless it happens to be a horseshoe — and by all means toss something over the left shoulder.

Odin, the Norse god, possessed two ravens that were sent out each morning to gather intelligence for their master. By evening they returned, perched on his shoulders and whispered to him what they had observed. That became a part of the people's belief. Then the raven, originally a beautiful white bird, was changed to black as punishment for having babbled so much.

Such crude, primitive people, we say. And yet, our difference is in form rather than substance. Time changes little. Yesterday and today are alike, where the nature of man is concerned. Being "superstitious," unless the case is extreme, does not even in this age set a person apart from his fellows. It is a favorable omen if the week can be started with a fair stroke of business on Monday morning. Only the other day a hard-headed, successful businessman, about to close an important deal, was overheard to say: "I don't want to talk about it because then nothing happens." The deal was later advantageously concluded, presumably aided by the fact that the rules of the jinxes had been so cautiously observed.

Old superstitions never die — they don't even fade away. Ground-hog day, an American tradition, is further evidence of how these things live on and on. The possibility of being hexed remains common in some localities in the United States, and such a spell is said to be very hard to break. If a cow looks at you and lows you are just about a goner; among the English it is held as good fortune. Even perpetual youth awaits one who carries an acorn in his pocket. There is something in human nature that such delusions feed on, defying both time and ridicule.

Chaucer wrote about the fears that even in that remote period centered about Friday, and Napoleon Bonaparte got what was considered a direct warning not to bring his army into Russia in 1812 when his horse stumbled and threw him as he was about to cross the last bridge — over the Niemen River. At least one historian has said: "That was a bad sign; a Roman would have turned back." Many of the fears that exist today were entertained in Old Testament times, and may have been ancient then. So they have had centuries in which to take countless forms, each with its staunch defenders and ranging from the ludicrous to the profound — confessed with outward levity though inward seriousness.

While there is assuredly nothing in the present to rival the days of Cotton Mather, when the supernatural was in the guise of doctrine in parts of New England, what prevails is deep-rooted and varied. Fortunately, it assumes pleasant forms as well as gruesome, as, for example, the nymphs and goddesses of mountains, woods and streams that have caught the imagination of the world's great composers and artists — traditions that refuse to be dimmed. In fact, belief in miraculous agencies, scary as well as reassuring, is so prevalent that we now find them listed in compendiums, including a recent work bearing the title *Encyclopedia of Superstitions,* where the student may find guidance on his path to learning and, of course, become up to date. Thus, at long last, the subject is being raised to the status of accepted lore.

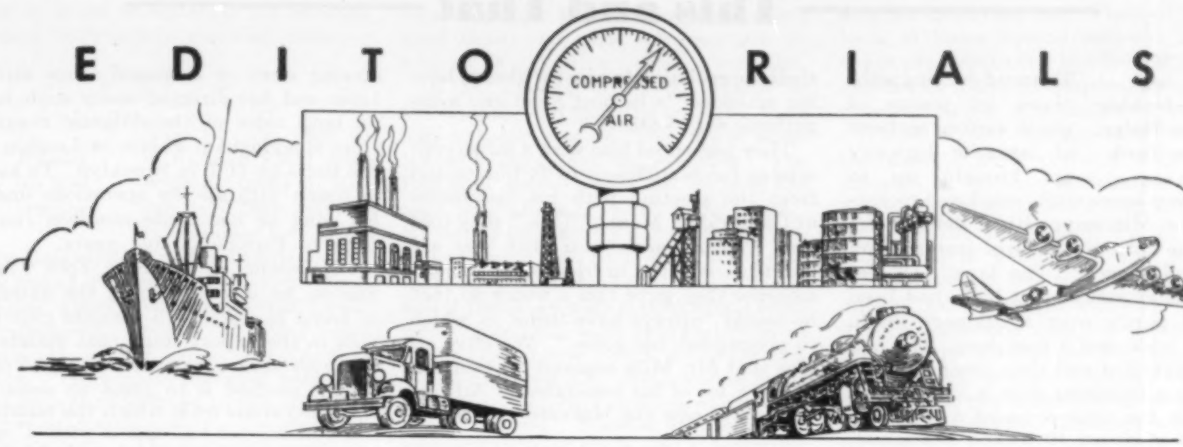
FRIDAY
13th

That being the case, far be it from a novice in the realm of the mysterious to try to discourage anything so amusing and obviously harmless. The author grew up in a Midwest rural community where there was also a bit of speculation as to the occult. Everybody there took time out for forenoon and afternoon lunch. It was discovered that the housewife of a certain neighbor always hid a raw potato, peeled in an odd manner, in the big lunch basket that was brought out into the field at threshing time for these between-meal snacks.

Nothing ever seemed to go wrong with the elements or the equipment — not at the Nelson's. If the wind was to blow, the rain to pour, the machinery to break down, or an accident to occur, those disasters just seemed to have to wait until the crew and equipment had moved to some other farm. After years of this uncanny experience there were those who commenced to wonder if, after all, that peculiarly peeled potato could have had something to do with it. Which is another indication that man's interests, always intrigued as he is by the fantastic, run freely to other things than machines even in a mechanical era such as ours. Perhaps, if we understood why superstitions live on and flourish as they do, we might know a lot more about human nature than we do.

Note: The foregoing material was written by J. A. Danielson, vice-president of Danielson Safety Valves, Inc., and was inspired by the illustrated article on "The Muquis" that appeared in our March, 1952, issue.

EDITORIALS



CLIMATE AND INDUSTRY

FACTORS that ordinarily influence the location of an industrial plant include availability of raw materials, labor, power, fuel, water, transportation, desirable site and nearness to markets. Only in rare instances is climate considered, but it is given as one of the main causes of a mild industrial boom now underway in the Rocky Mountain states of Utah and Colorado.

John D. Garwood, a post-graduate student at the University of Colorado, based his thesis on a study of 116 firms that set up business in the two states between January, 1946, and April, 1951. To get his answers, he visited each establishment and interviewed the proprietors. Approximately one-fourth of them stated that they were attracted to the area primarily by its climate.

In numerous cases, the concerns incurred higher production costs and a more limited market in order to settle in Colorado. One new company, in fact, obtains 95 percent of its materials and sells 95 percent of its product east of the Mississippi. Its owners nevertheless choose to keep the seat of business in the West. It is obvious that the profit motive does not rule such selections. It is probably true, however, that high income taxes are a contributing influence. Realizing that Uncle Sam, regardless of where they are situated, is going to take such a healthy bite out of the net that there won't be much left, some businessmen figure they might as well make their reduced profits in a section where climate is favorable to pleasant living.

Mr. Garwood's investigations disclosed, however, that in a few instances the climate brings about production advantages. These were not anticipated when the establishments were located in the West and came as welcome bonuses. By way of illustration, a firm that makes aluminum pistons in Pueblo, Colo., found the dry air favorable to sound castings. In the high-humidity Great Lakes region, where the company formerly operated, the molten metal often attracted moisture, so that blowholes resulted. Rejections for this cause have declined substantially in Colorado.

A concern making electrical instruments has benefited by the dry climate because the metals it uses do not rust or tarnish readily. Likewise, a printing firm discovered that ink dries quicker and paper retains its dimensions better than in areas where the humidity is high.

Knowledge of these unsuspected advantages will, no doubt, serve to attract other lines of business that can profit by them. It is true, of course, that favorable factory climate can be manufactured anywhere in this age of air conditioning, but if it can be obtained as a gift from Nature, worth-while savings can obviously be made.

•

HUGE DRAINAGE SCHEME

THE anthracite coal-mining industry is beset by a spate of problems. Year by year it is confronted with stiffer competition from other fuels and meanwhile finds itself less and less able to fight back effectively because its own production costs are ever rising. A few figures tell the unhappy story of the industry's recent history. In 1928, output was 74 million tons and employees numbered 159,000. In 1951, production totaled only 42.4 million tons and there were 70,000 workers.

Production of anthracite per man-day amounts to but 2.78 tons, as compared to 6.42 tons in the case of bituminous coal (1947 figures). Numerous factors account for this wide difference. According to the Pennsylvania Department of Commerce, the two main reasons why anthracite is more expensive to mine than any other kind of coal are, first, a lack of tested automatic mining machinery suitable for the conditions that prevail and, second, the enormous volume of underground water that has to be handled in the Pennsylvania fields. During the five years from 1944 through 1948, an average of 19 tons of water was pumped for each ton of coal extracted from underground.

In an effort to solve the water-pumping problem, the U. S. Bureau of Mines has for several years been investigating the possibility of driving a deep-level drainage tunnel. Bores of this kind are rather common in older metal-mining districts, but somewhat unusual in coal-producing areas. To be of maximum service, a tunnel would have to be advanced close to sea-level grade, as some coal workings are already at or below that horizon. To meet this condition, it is necessary to find a route where the discharge end is at tide-water level, with the tunnel sloping upward from there to its objective in the mining area on a low gradient.

These desiderations could be reached, the Bureau finds, by running a 100-mile gallery from a point in Maryland, downstream from the Conowingo Dam on the Susquehanna River, northward to Glen Lyon, in Luzerne County, Pa. A preliminary report terms the project feasible from an engineering standpoint and predicts that it will take two more years of study to obtain all the information required for a final report.

It is expected that the drainage course would start out as a 13-foot bore and be enlarged to 16 feet southward of Pottsville, Pa., at which point some laterals would bring in water from both sides. The cost would be somewhere between $150 million and $175 million, it is believed. One suggestion is that the Commonwealth of Pennsylvania, the Federal Government and the various coal-producing companies join in financing the scheme. So far it is only an idea.

The water would empty into the Susquehanna, and engineers say it would not be contaminated by mine wastes. Some proponents of the proposal advocate transporting fine coal in the stream of water, thus cutting delivery costs to Baltimore, Washington and other market centers near the tunnel route.

This and That

Mud-Jacking Takes Bulge from Tank

The mud-jacking technique, by means of which sunken sections of concrete highway are brought up to grade, was successfully employed recently in the Mississippi River delta to relevel the bottom of a large storage tank that had sagged. The tank, 110 feet in diameter and 48 feet high, had been erected partly over a drainage ditch, 20 feet wide and 4 feet deep, that had been backfilled and then compacted by running a bulldozer over it. Soundings taken in the tank revealed a local settlement of about 12 inches, maximum, where the ditch ran. Examination indicated that any additional settlement would put the bottom plates under serious tension.

The owners, Mid-Valley Pipe Line Company, considered relocating the tank or floating it off its site, driving piles there, and returning it. Either course would have been expensive and time-consuming, so mud-jacking was investigated. L. C. Pope, a contractor who had used the method in highway work, was retained. At different points he inserted horizontally under the depressed area of the tank four lengths of 1¼ and 1½-inch pipe varying in length from 20 to 53 feet. Using an air motor for turning them and water and compressed air for jetting material out of them as they advanced, the pipes were readily driven. The longest one was put in place in 30 minutes.

With a mud pump having a capacity of 10-15 cubic yards per day, a mixture of four or more sacks of Portland cement to each cubic yard of soil was injected. In all, 90 cubic yards was placed over a period of several days, the pipes being withdrawn at night to keep them from holding fast. Four feet of oil was in the tank at the time, but the bulge was taken out of the bottom without difficulty. The cost of the work was $2000, or around $22 per cubic yard.

* * *

A Man with Friends

In June, Edwin W. Mills of Arizona attended the fiftieth reunion of his class at Harvard University. This, in itself, is a fact of no great importance, but the way it came about is interesting. Mr. Mills is president of the Arizona Small Mine Operators Association, an organization in which he has been active during the twenty years he has been engaged in mining in the Salome District. Apparently he never amassed much money, but he did make a lot of friends. Learning of the forthcoming reunion, 75 of them gathered at Salome on June 3 to express their appreciation to him for always having extended "a helping hand and sympathetic ear to others."

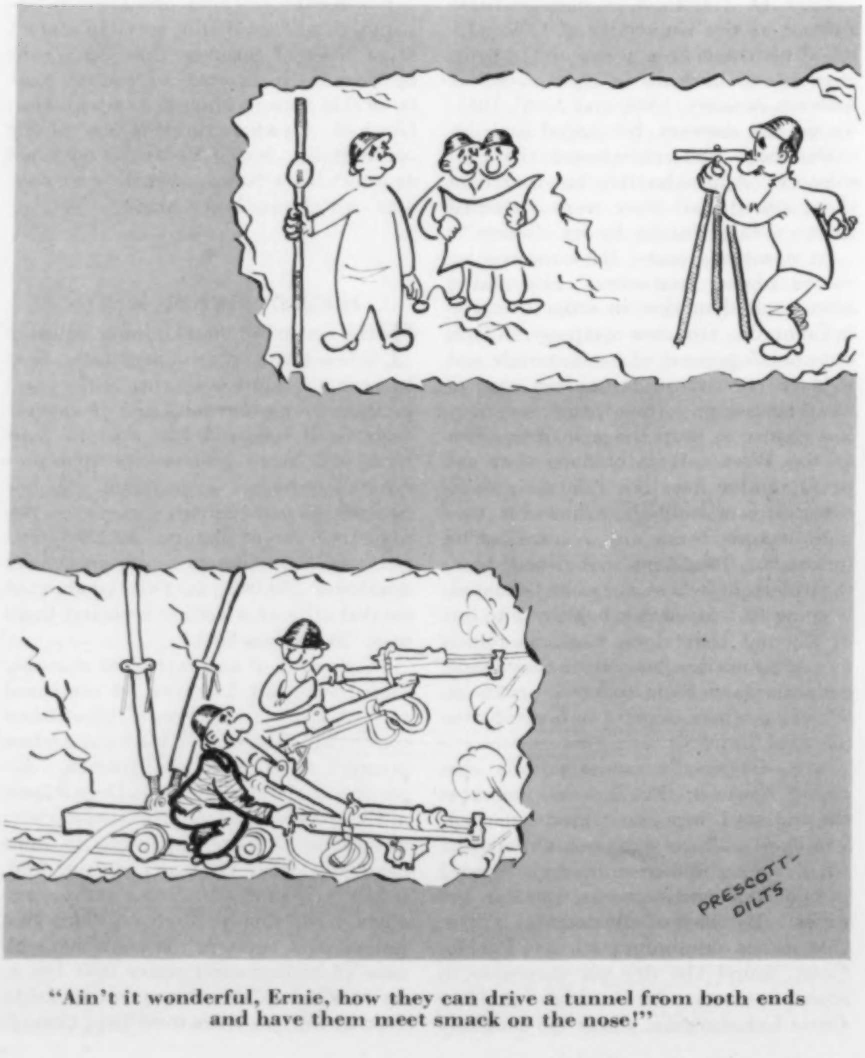
They presented him with a purse containing funds sufficient to fly him to and from the meeting with his classmates at Cambridge, Mass. "This," they told him, "should show you that you are wealthy—wealthy in friends." For good measure they gave him a watch so that he would "always have 'time' in which to accomplish his goals." We have an idea that Mr. Mills enjoyed the reunion, as did a lot of his associates in Arizona who never saw the Harvard campus.

* * *

Doctors Ailing Structures

In 1947 a Danish engineer, Herluf Rask, came to the United States to repair the Washington Monument. He hasn't got at the job yet because Congress hasn't appropriated the funds for it, but there has been no lack of work in the meantime. Rask is a specialist in restoring worn or damaged stone structures and has directed many such jobs on both sides of the Atlantic ranging from Buckingham Palace in London to the Borough Hall in Brooklyn. To keep in touch with all the operations under his wing he has made nineteen round trips to Europe in five years.

At present, as the *New York Times* relates, he is refurbishing the exterior of India House, a 115-year-old club for men in the export trade that stands in Hanover Square in downtown New York. Rask's method is to grind up some of the same stone from which the building was constructed and mix it with a special binder, the composition of which he does not divulge. When an area to be repaired has been sandblasted and the mixture applied and allowed to dry, it looks just like the surrounding stone and can be cut or ground into any desired shape. Ordinary cement mixtures would not only differ from the original material in appearance but would also separate from it in time, opening new cracks. The Rask method costs a fourth to a



"Ain't it wonderful, Ernie, how they can drive a tunnel from both ends and have them meet smack on the nose!"

third as much as replacing the affected sections with newly quarried stone.

* * *

Report on Red Tractors

Two tractors built in a Russian plant that were captured in Korea have been carefully examined by experts of the Caterpillar Tractor Company, and their report on them is of interest. They consider them "well-engineered, well-manufactured copies" of their own Model D7, second largest unit the firm makes. Inspection revealed that the machine was redesigned to suit the more convenient metric system—"no mean engineering feat." The Russians evidently consider appearance unimportant, because many parts are rough on the outside. However, that is not the case where good finish and close tolerance are required. Antifriction bearings are good.

J. M. Davies, research director at Caterpillar, said that the tractors "were a great surprise to us. They are of much better quality than we expected. The Russians know where to make parts hard and where to make them tough." He added that he did not think the machines would last as long in service as their American counterparts. It is believed that they were copied from Caterpillar units that were obtained from us under Lend Lease about ten years ago. When captured, the tractors were being used to pull military equipment and supplies in Korea. Neither was equipped with a bulldozer blade and a hydraulic lift to operate the blade, which are standard on American models.

THE DOCTOR LOOKS INTO YOU

Slender, Rodlike Device Can Be Slipped into Stomach, Bronchial Passages or Other Body Cavities for Diagnosis or Treatment

J. D. Ratcliff

Reprinted by permission from "The Reader's Digest," June, 1952

A PHYSICIAN notes a vague shadow on the X ray of a patient's stomach. A life may depend on an accurate diagnosis. Until three years ago there was no way to decide short of surgery, but now, with the aid of an instrument called an operating gastroscope, a physician can see hidden conditions and give treatments which often do away with extensive surgery.

The gastroscope is but one of dozens of endoscopes (Greek for "look inside"), each designed for a particular job. These instruments are slender, rodlike devices which can be slipped into the stomach, bronchial passages and other body cavities. No medical instrument has improved so rapidly as have endoscopes in the past few years.

Thirty-four inches long, and smaller in diameter than the little finger, the gastroscope is probably the highest expression of the instrument maker's art. Its upper portion is rigid, its lower half flexible — so it can slip into the stomach, which is at an angle in the body. A brilliant electric-light bulb, the size of a grain of wheat, is at the tip. The gastroscope contains 29 optical elements, so the physician can see, no matter how the barrel bends and twists. Although the optical elements may be no larger than a pencil eraser, they are ground to the same precision as lenses and prisms used in bomb sights and microscopes.

Vital gadgetry is packed in the gastroscope's pencil-sized circumference. An air system connects to a rubber bulb, enabling the physician to inflate the stomach like a toy balloon; disease might lurk in hidden folds. Down the instrument's shaft is slipped a pair of tiny, clam-mouth forceps with which the physician can snip off a bit of any suspicious tissue. Study by a pathologist helps to determine whether it is a cancer that should be surgically removed or an ulcer that will heal if given proper care.

How can anyone but a professional sword swallower get this instrument down his throat? Actually, three out of four patients have no difficulty. First, nerves are calmed by an injection of morphine or a barbiturate. A gargle of a novocain-like drug deadens the gag reflex in the throat. Then the head is drawn back to provide a passageway as straight as possible and the tube is gently inserted. The examination usually takes only five to fifteen minutes.

In general, all endoscopes work in the same manner. First, the sheath—a slender hollow tube—is introduced. A variety of instruments can be slipped down its barrel: telescopes which see in a forward direction, at right angles and to the rear; grapple hooks, irrigation and suction devices; pea-sized electromagnets used for picking up metal fragments. There is even photographic equipment for taking pictures of the interior of the stomach and other organs.

Of all this family, the bronchoscope is best known. It is regularly used to retrieve marbles, whistles, peanuts and other things children have sucked down their windpipes. This instrument has another lifesaving use. Fluid often collects in lungs during surgery, and in times past frequently spelled pneumonia and death. Today it is sucked up through a bronchoscope in a matter of seconds.

These almost unbelievably versatile instruments even perform surgery — through an incision little larger than a pencil. In tuberculosis a lung often adheres to the chest wall, so that it is impossible to collapse it and possibly heal tubercular lesions. This condition once called for drastic surgery. Today, if such adhesions aren't too extensive, they can be severed quickly and easily with a thoracoscope. Through one tiny incision, the physician introduces a slender viewing device. Through a second, he inserts a tube equipped with a high-frequency electrical cutting loop. Watching with one instrument, he works with the other — cutting adhesions electrically as accurately as he could with a knife.

He can stanch bleeding with an electric cautery loop or he can introduce a swab of adrenalin through the tube. At the end of the operation he may, if he wishes, wash out the chest cavity with a saline solution. All this is accomplished through incisions which heal in days instead of the weeks that might be required if the chest were entered by usual surgical procedures.

In many cases stones in the bladder can be disposed of without major surgery by means of a cystoscope. After the cystoscope is introduced, the bladder is inflated with distilled water to aid the surgeon's vision. Then he introduces a tiny stone crusher. Delicate in appearance, the jaws of the crusher can exert pressures up to 780 pounds per square inch! Pulverized stones are flushed out, and the patient goes home shortly afterward — instead of being faced with a long stay in the hospital.

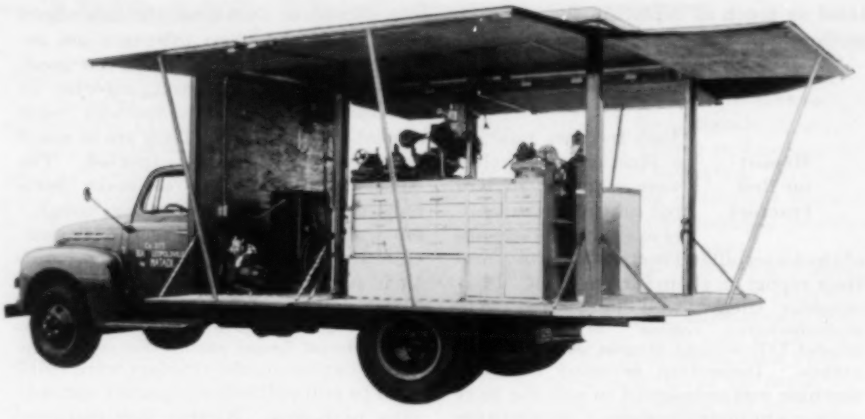
Until the cystoscope was perfected some years ago, doctors diagnosing a kidney disease found difficulty determining which kidney was ailing. Today, with a cystoscope, the surgeon inserts a catheter in the tiny passage from bladder to kidney and takes samples of the urine secreted by each kidney. Analysis tells which organ is diseased.

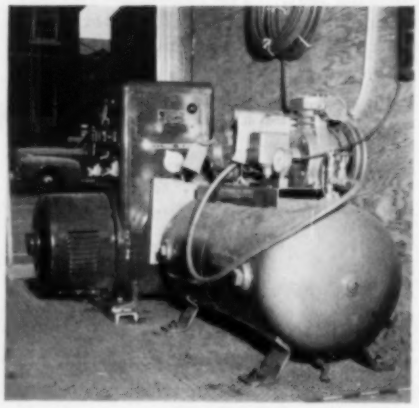
The principle of the endoscope was first suggested by Philip Bozzini, of Frankfurt am Main, Germany, in 1805. A variety of crude devices to focus light from reflecting mirrors through a tube into the body were later developed. All had the same drawback: enough illumination could not be reflected into body cavities to permit good vision. Development of the instrument had to await modern technological developments such as minute light bulbs and intricate lens systems. But today's endoscopes, enabling better diagnosis and treatment, are making dramatic contributions to medical progress.

Machine Shop on Wheels

FOR use in isolated sections or where operations are spread over a large area, Cemco Industries, Inc., of Galion, Ohio, builds a mobile machine shop on a truck or trailer body. Called "traveling trouble-shooter," it has been designed with the idea that it should be complete within reason, that its equipment should be arranged compactly but convenient of access, and that it should provide maximum dependability by including only tools and equipment of recognized high quality.

These units are used at remote jungle airports, on expansive plantations where considerable scattered machinery has to be maintained, on pipe-line construction jobs, on large highway projects, and in oil fields. They are in service in both the Americas, in Africa and Asia.





TRUCK AND COMPRESSOR

A 2-ton standard truck equipped as a Cemco mobile machine shop is shown at the top with the sides and rear end opened to form a roofed-over platform on three sides. The truck floor measures 95x150 inches. The same equipment can be had on a truck trailer. Pictured at the right is the Ingersoll-Rand air compressor and, beyond it, a Hobart welder.

To take care of almost any kind of mechanical trouble that might develop, each portable shop contains an 11-inch bench lathe, an acetylene generator and electric welder, a 15-kw generator, drills up to 1 inch in size, a forge, an air compressor, an Impactool with accessories (a quick-changing chuck, various bits, drills, taps, screw drivers and the like), a bench grinder, vise, a Bonney tool set and other units. There are 33 major items and 190 additional ones. Some, such as lamps, files, sockets, etc., come in duplicate or in several sizes so that the entire list runs into more than 500 individual articles, not including small ones like 50 pounds of horseshoe nails.

The compressor is an Ingersoll-Rand Type 30, air-cooled model driven by a ½-hp gasoline engine and mounted on a 4-cubic-foot receiver. It has a capacity of 2.7 cfm at 150 psi pressure. In addition to running the Impactool, which also is of I-R make, the machine furnishes air for spray painting, operating a grease pump and blowgun, inflating tires, etc. The compressor, as well as the generator, can be taken from the truck when necessary and carried to a remote place that cannot be reached otherwise.

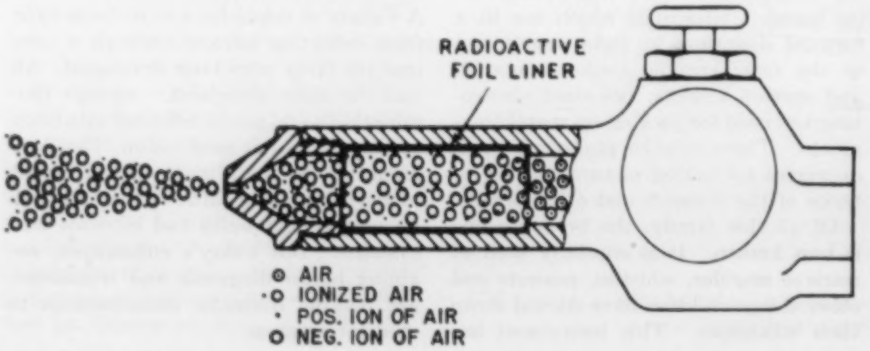
Radioactive Air Gun Neutralizes Static Electricity

A PNEUMATIC gun, developed by Canadian Radium & Uranium Corporation, represents one of the first nondestructive applications of atomic energy. Briefly, its purpose is to ionize an air jet through the use of a radioactive foil liner or filter and to apply the air to nonmetallic surfaces to dissipate electrostatic charges—those minute particles of high-voltage electricity that give a man a jolt when he slides across the seat of a car and touches the metal doorknob.

Virtually all types of nonmetallics such as leather, wood, plastics, rubber and glass receive such charges as the result of atmospheric conditions and friction as well as from sources of electric current. Though they may be quite intense (attain an electromotive force of more than 700 volts in the case of the example cited in the preceding paragraph) they are usually harmless. However, there are circumstances under which static electricity is dangerous.

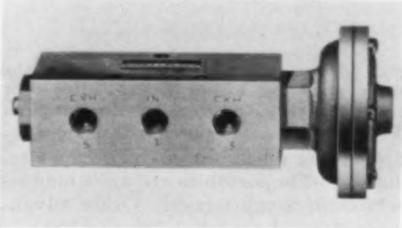
A painter working on a scaffold may fall and be seriously injured or killed after receiving the same sort of jolt that merely startles a motorist. A spark attributable to a discharge of static electricity may start a fire or cause a serious explosion where combustible materials are being handled or in the mist-laden atmosphere of a paint-spray booth. A charged friction or conveyor belt may attract particles of dust or foreign matter and thus contaminate materials being processed or reduce the efficiency of machine tools.

Radioisotopes of polonium, created by the same sort of electrical bombardment as that by which uranium is converted into an A-bomb explosive, are incorporated in the filter of the aforementioned gun, and their radiations will give the air the electrostatic potential required to neutralize charges on nonmetallic surfaces. The tool can be manually or mechanically operated without danger to the user with air under pressure supplied by any standard compressor and will, it is claimed, remove foreign matter such as dust as well as static electricity from materials that must be finished or otherwise processed.

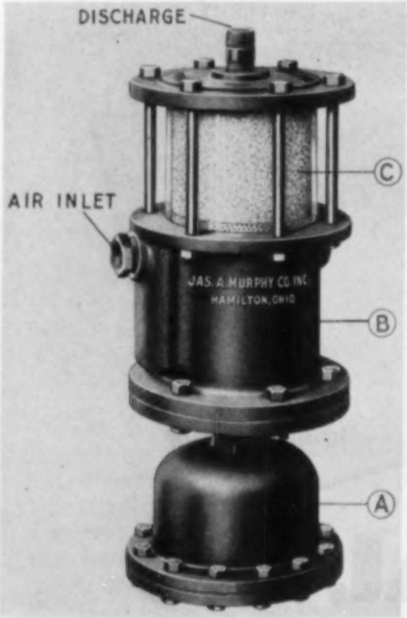


Industrial Notes

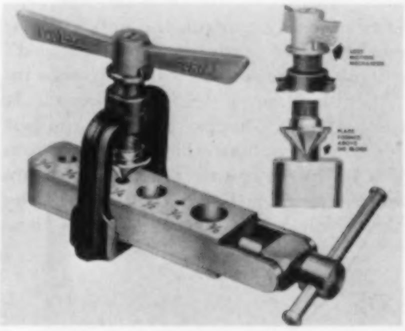
C. B. Hunt & Son, Inc., has introduced a series of Quick-As-Wink spring-return, single-plunger diaphragm valves for use where only low-pressure air is available for pilot control. They can be operated with air at from 12 to 35 psi on the diaphragm and are suitable for service in laboratories and for industrial and commercial applications within their limits. The valve housing is of aluminum, and the plunger, of stainless steel, is hollow with precision-placed radial ports. The spring return is under the diaphragm push plate permitting open-end exhaust, if desired. The manufacturer reports that the improved design prolongs the life of the valve parts and packing and that units can be disassembled without disturbing the main piping. They are furnished tapped for 1/8- or 1/4-inch pipe connection for 2-, 3-, double 2-, 4- and 5-way use with air, oil or water at line pressures up to 125 psi (also vacuum) and temperatures not exceeding 150°F.



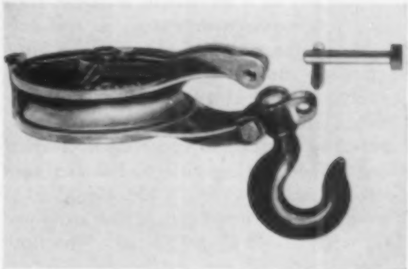
To its standard line of products, James A. Murphy & Company, Inc., has added a separator-filter that is designed to remove condensate as well as vapors from compressed air. The unit consists of trap "A," a separator "B," and a cylinder "C" containing a desiccant. Oil and water vapors remaining in the air after its passage through the separator is extracted by the desiccant which, in the course of the process, changes color gradually from bottom to top. When it is a deep amber throughout it is spent and it is time to recharge. Replacements are available and made quickly. The moisture removed from the air collects in the trap and is discharged automatically. The combination separator-filter can be obtained with a 1/2- or a 3/4-inch pipe connection.



By means of a new tool announced by The Imperial Brass Manufacturing Company it is possible to flare tubing of soft copper, brass, steel and aluminum and automatically burnish the face of the flare. That is done by a "lost-motion mechanism" which, when backing off the cone after the flare is made, disengages the feed during the first revolution, thus causing the cone to give the flare a highly polished finish. The cone is of a special faceted type. The flare is formed above the bar instead of against a bevel in the bar, as is common practice. As a result, the original wall thickness is maintained at the base of the flare. The No. 500-F Rol-Air Flaring Tool, as it is listed, makes 45° flares on tubing ranging in outside diameter from 3/16 to 5/8 inch for standard S.A.E. flared fitting joints.

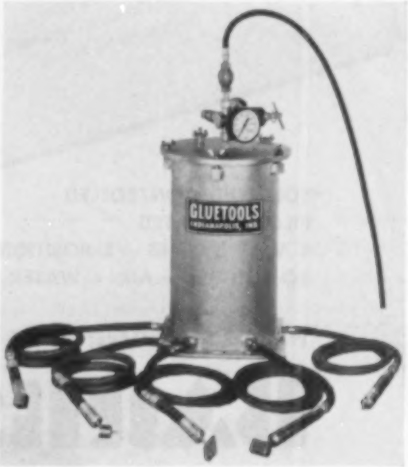


Sauerman Bros., Inc., has increased its line of Durolite tempered-steel sheave blocks with a unit that is designed essentially for slushing, mucking and wrecking operations. The sheave and frame are made of heat-treated alloy steel; the swivel fittings are quick opening and free moving; and a bead cast in the frame protects the rim of the sheave and prevents fouling of cable. Though like the standard blocks in the matter of general specifications, the slusher block has several new and important features: a wider, flatter sheave groove that permits the use of larger cable than a standard block of the same diameter; an extra-wide throat opening that allows the passage of knotted cable; and lighter weight, compared with a block of similar capacity, to facilitate handling in tight places.

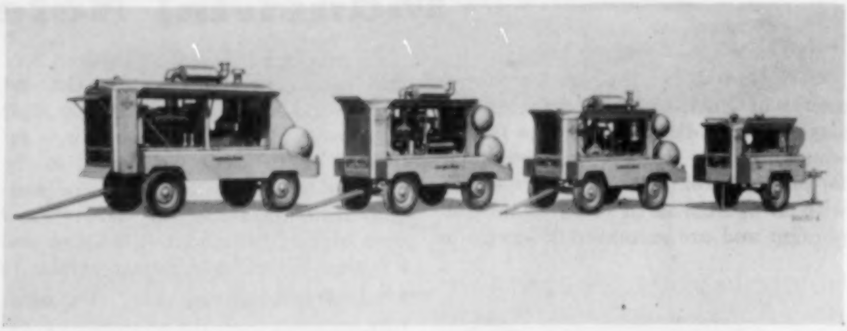


Three new kinds of Neoprene liquid coating for maintenance purposes have been introduced by the Mercer Rubber Corporation. They can be applied by spraying, brushing, dipping, rolling or troweling and are said to insure uniform sheets of Neoprene that will not chip, crack or peel and will give metal, wood or concrete long-lasting protection against the corrosive action of chemicals and water. Type N-200 is designed primarily for coating equipment such as pumps, sea valves, pipes, outboard shafting and acid tanks; N-600 makes floors, steps and ramps skidproof; and N-700 is an oil- and grease-resistant liquid that protects tank interiors, floors, etc., against high temperatures, steam, acid fumes, solvents and general wear.

Looking like the tentacles of an octopus, the hose lines connected to the pressure tank pictured are equipped with heads for spreading glue on materials such as wood, fabrics, plastics, cardboard and paper. The 3-gallon unit has four outlets which can be doubled by the use of "T" fittings, thus serving eight operators. The heads vary in type and most of them are made to meet customers' needs. From left to right are



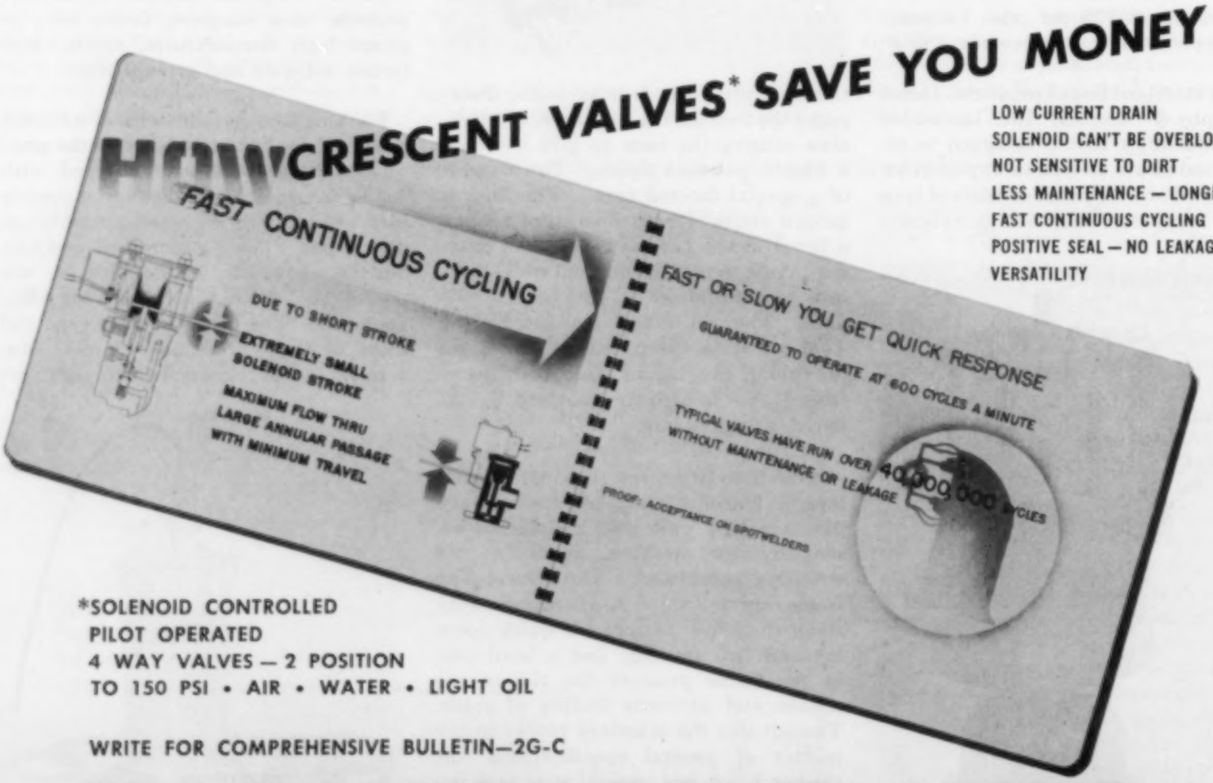
shown: a block spreader for applying adhesive simultaneously to two sides of an assembly at a 90° angle, a dowel-hole head, a groove applicator, a flat-surface head for putting glue at one time on two or more strips from ¼ inch to 5 inches wide, and a utility spreader which feeds a thin ribbon of adhesive. A recently developed type has a knurled roller which applies glue to flat surfaces up to 6 inches wide. Cold liquid glue is used and is forced out of the pressure tank with air at up to 30 psi. The flow is regulated by an automatic control valve built into a flexible barrel which is right behind the spreader and provided with a grip handle. When the operator puts pressure on the head the barrel bends and opens the valve, allowing the adhesive to pass through it and openings in the spreader. When pressure is released, the barrel straightens, the valve closes and flow stops. Tanks range in capacity from 1 to 10 gallons and have one, two or four outlets.



Early last year Ingersoll-Rand Company introduced its 600-cfm Gyro-Flo portable compressor of revolutionary design; today the manufacturer is prepared to supply three smaller sizes—315, 210, and 105 cfm—of the same type, according to a recent announcement. Like the first model they are equipped with a 2-stage, oil-cooled rotary sliding-vane compressor which, it is said, has eliminated most of the problems encountered with reciprocating units in the portable field. The former has no valves to leak; no pistons, rings, rods and clutch to wear; while its continuous rotary action insures a steady flow of air free of pulsations. The air is discharged at less than 200°F under normal operating conditions, and this, together with thorough oil separation, prevents hose deterioration attributable to heat and oil. Another feature of the line is the Air Glide capacity control, the only stepless regulator that combines "floating speed" control of the engine with variable intake unloading of the compressor. It automatically keeps the air output smooth throughout the full range from 0 to 100 percent and holds the pressure steady between 100 and 110 psi. The 600-cfm portable is powered by a General Motors diesel engine, and all the other sizes by either a GM diesel or a Continental Red Seal gasoline engine. Weighing up to 40 percent less than reciprocating machines of equal capacity, the Gyro-Flo portables are more maneuverable in rough terrain. Other advantages claimed are reliability and low cost of operation and maintenance.

Timbering is a major item of overhead expense in mines, especially in collieries, according to a U.S. Bureau of Mines information circular released by the Secretary of the Interior. To cut the cost, it is recommended that coal companies owning stands of timber to be used for the purpose impregnate them against decay and insect damage by injecting certain chemical solutions into the base of the living trees in such a way that they'll be carried to the foliage

HOW CRESCENT VALVES* SAVE YOU MONEY



FAST CONTINUOUS CYCLING

DUE TO SHORT STROKE

EXTREMELY SMALL SOLENOID STROKE

MAXIMUM FLOW THRU LARGE ANNULAR PASSAGE WITH MINIMUM TRAVEL

FAST OR SLOW YOU GET QUICK RESPONSE

GUARANTEED TO OPERATE AT 600 CYCLES A MINUTE

TYPICAL VALVES HAVE RUN OVER 40,000,000 CYCLES WITHOUT MAINTENANCE OR LEAKAGE

PROOF: ACCEPTANCE ON SPOTWELDERS

LOW CURRENT DRAIN
SOLENOID CAN'T BE OVERLOADED
NOT SENSITIVE TO DIRT
LESS MAINTENANCE — LONGER LIFE
FAST CONTINUOUS CYCLING
POSITIVE SEAL — NO LEAKAGE
VERSATILITY

*SOLENOID CONTROLLED
PILOT OPERATED
4 WAY VALVES — 2 POSITION
TO 150 PSI • AIR • WATER • LIGHT OIL

WRITE FOR COMPREHENSIVE BULLETIN—2G-C

BARKSDALE VALVES

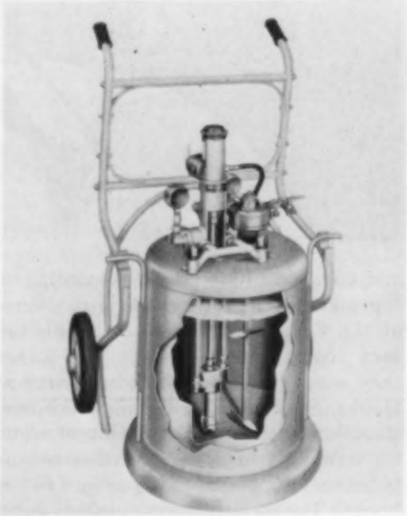
1566 EAST SLAUSON AVENUE • LOS ANGELES 11 • CALIFORNIA

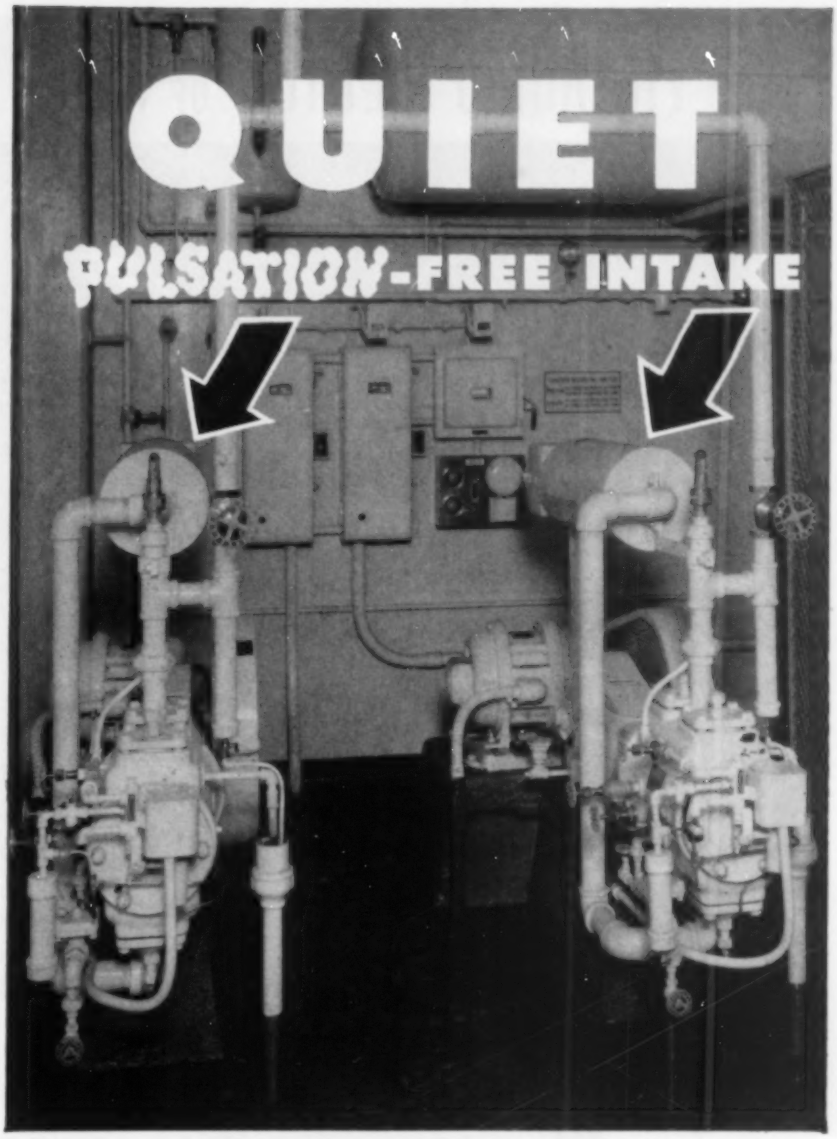
by the sapwood without entering the bark or the heartwood. The idea is based on tests made some years ago by the Department of Agriculture in a California forest laboratory. Timbers so treated can be used without removing the bark and having to wait for the wood to season, both of which are advantageous from the standpoint of cost.

For the convenience of users and distributors, Thermoid Company has reduced its line of molded rubber hose from eighteen to five basic types named, respectively, Aquair, Powerflex, Versicon, Versiflex and Utility. They are suitable for delivering air and other gases, water, steam, oil, gasoline, etc., and are color coded to prevent confusion in stocking and application.

To prevent building up static and exposing operators to electric shock, American-LaFrance-Foamite Corporation has provided their larger-size carbon-dioxide fire extinguishers using hose connections with a type of horn that carries away the charge as fast as it is produced. This is achieved by a pair of copper conductor strips that extends along the inner wall of the plastic horn and is electrically bonded through the nozzle and metal braid of the hose to the carbon-dioxide cylinder.

With plant maintenance in mind, Gray Company, Inc., has introduced a heavy-duty spray-gun pump that can be used as a stationary unit or mounted on a Sta-Level hand truck with large rubber-tired wheels. Called Paintmaster, it takes its supply direct from 5- or 10-gallon shipping containers. The pump is of the double-acting reciprocating type and, together with the agitator, is air operated. The latter has nonsparking dual aluminum blades that are adjustable to any depth and keep the material well mixed independent of the operation of the pump. No pressure is exerted





with

MAXIM SILENCERS

● Maxim makes silencers for compressor intake, vacuum pump discharge, blower intake or discharge, internal combustion engine exhaust or intake, high velocity steam, air or gas discharges, spark arresting and heat recovery silencers.

Consult MAXIM

DR. SHUSH

THE MAXIM SILENCER COMPANY
Dept. W.L., 61 Homestead Ave., Hartford 1, Conn.

Gentlemen: Please send me your bulletin on silencers for
☐ Compressor Intake ☐ Internal Combustion Engines
☐ Steam Blow-off ☐ Spark Arresting ☐ Heat Recovery.

Name ____________________

Company ____________________

Address ____________________

____

4MX52

THE VICTAULIC® METHOD OF PIPING

VICTAULIC
VIC-GROOVER

EASIEST WAY TO MAKE ENDS MEET

"VIC"
VICTAULIC

Sizes—¾" through 60"

Time- and money-saving "Vic-Groover" Tools are only part of the *complete* Victaulic Method. Portable and easy-to-use "Vic-Groovers" are available in 9 sizes up thru 6", prepare pipe ends on the spot for quick easy hook-ups with Victaulic Couplings and Fittings, and they're automatic as to groove positioning and depth!

The Victaulic Method means a *complete* modern piping system: easy-to-install Victaulic Couplings that guarantee leak-proof, positive-locked connections with a union at every joint . . . a complete line of versatile Full-Flow Elbows, Tees, Reducers, and other streamlined Fittings unique in their wide adaptability . . . plus handy "Vic-Groover" Tools.

It's easy to see why the name "Victaulic" stands for world leadership in a fast, dependable piping method. Make that next job ALL VICTAULIC and prove to yourself that whether it's new construction . . . repairs . . . or alterations . . . the Victaulic Method solves every piping problem.

You'll find you save time, work, and dollars with Victaulic — *"the easiest way to make ends meet."* FOR YOUR OWN PROTECTION . . . make sure you get VICTAULIC!

Write today for Victaulic Catalog and Engineering Manual No. 44- B

VICTAULIC
COMPANY OF AMERICA
P. O. Box 509 • Elizabeth, N. J.
Office and Plant: 1100 Morris Ave. Union, N. J.
Telephone: Elizabeth 4-2141

Copyright 1952, by Victaulic Co. of America

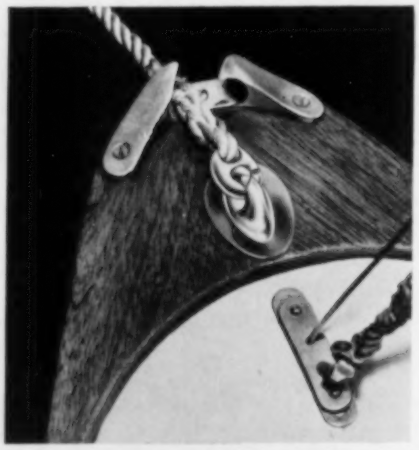
28th VICTAULIC YEAR

California: Victaulic Inc., 727 W. 7th St., Los Angeles 14
Canada: Victaulic Co. of Canada Ltd., 406 Hopewell Ave., Toronto 10
Export: Pipe Couplings, Inc., 30 Rockefeller Plaza, N. Y. 20, N. Y.

on the fluid, hence aeration is reduced to a minimum. In addition to paints and finishes, the outfit is constructed to handle many abrasivelike materials, as well as most of the vinyl- and plastic-base coatings. For these, a 10-gallon liner container is provided to facilitate mixing. The Paintmaster is said to be sufficiently powerful to permit the use of long hose lines or multiple spray guns even with heavy viscous materials applied in low-temperature areas.

Super-Hot is the name of a ready-mixed aluminum paint for which the Sheffield Bronze Paint Corporation makes broad claims. According to it, the coating becomes permanently bonded to well-nigh all metals when they are subjected to heat varying from 500 to 1600°F. It may be applied by brush, spray or dipping and used as a rust inhibitor or for finishing or decorating metal products. It is guaranteed not to crack, chip or peel.

Quick connector hooks of a new design for coupling hawsers, wire ropes or chains to each other or to stationary objects are being offered by Brummel Hook Company. They are made of Ternalloy, a high-tensile manganese bronze that combines lightness with strength and corrosion resistance. According to the manufacturer, it takes just a turn of the fingers to connect or to disconnect them, and once they are joined they stay joined. Known as Brummel Hooks, they are of solid one-piece construction with or without thimbles and are available in a variety of sizes and types including eye, nut, jaw and swivel hooks. The accompanying picture shows an eye hook with a mooring line fastened to a boat deck by a special fitting.



United States Steel Corporation has provided a ski hoist at its new Gary, W. Va., No. 14 colliery not as a recreational facility but to carry the miners, comfortably seated, to and from the portal to the wash house located at a higher level.

QUOTES

—FROM HERE AND THERE

Roof-bolted Tunnels

"With steel in short supply, several large tunnel projects have found it necessary to resort to roof bolting (instead of conventional supports) to keep going. Because of exceptionally good results, the practice is now accepted generally as standard procedure. This is indeed a tribute to the method in view of the long-standing opposition to its use . . . .

"In the tunnel industry, the extensive use of roof bolting probably started at the Keyhole Dam Diversion Tunnel in 1950. There, because of a shortage of steel, the Bureau of Reclamation permitted the contractor to employ roof bolts. The highly successful results obtained at Keyhole encouraged the New York City Board of Water Supply to permit the use of suspension type supports at the East Delaware Tunnel, currently being constructed by the Walsh Construction Company and B. Perini & Sons, Inc.

"The East Delaware Tunnel consists of 26 miles of deep rock tunnel with a driven diameter of about 13 feet. It is a project of such magnitude that techniques and procedures have had ample opportunity to develop. Roof bolting is now firmly established as routine practice . . . . It is quite possible to reduce . . . excavation by as much as 10 or 15 percent and the amount of concrete by well over 30 percent by the judicious use of roof bolts.

"A less obvious beneficial effect . . . is the influence on the ventilation in the tunnel. By improving the friction characteristics of the tunnel walls, the effective area may be increased by as much as 45 percent. . . . In equivalent sized drifts of 10,000 feet length and approximate cross section of 14x7 feet, the roof bolted drift showed a power saving (for ventilation) of $20,300 per year over the conventional timbered section."

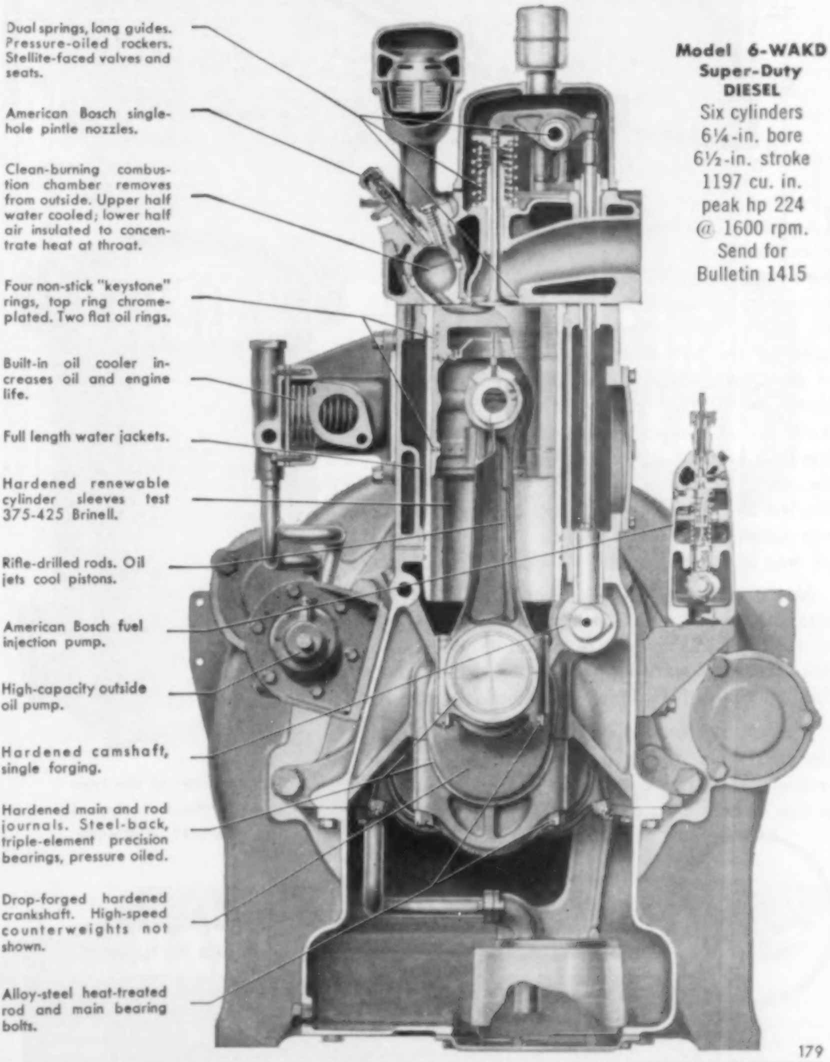
Philip S. Miller, consulting engineer, in Mining Congress Journal, June, 1952

Pneumatic Stowing

"Solid stowing (backfilling of mined-out spaces), even when mechanized, is still too expensive to be applied generally. The most fully developed stowing machines use compressed air to blow the rubbish through pipes into the space to be packed. In 1947-51, more and more of these 'pneumatic' stowers came into use, especially in South Wales; in 1946 six machines stowed 40,000 cubic yards of material; in 1951, 57 machines handled nearly 1,500,000 cubic yards. At the end of 1951, the board was developing a machine designed by its own staff to use much less compressed air

WAUKESHA

RUGGED POWER...Slick and Smooth!

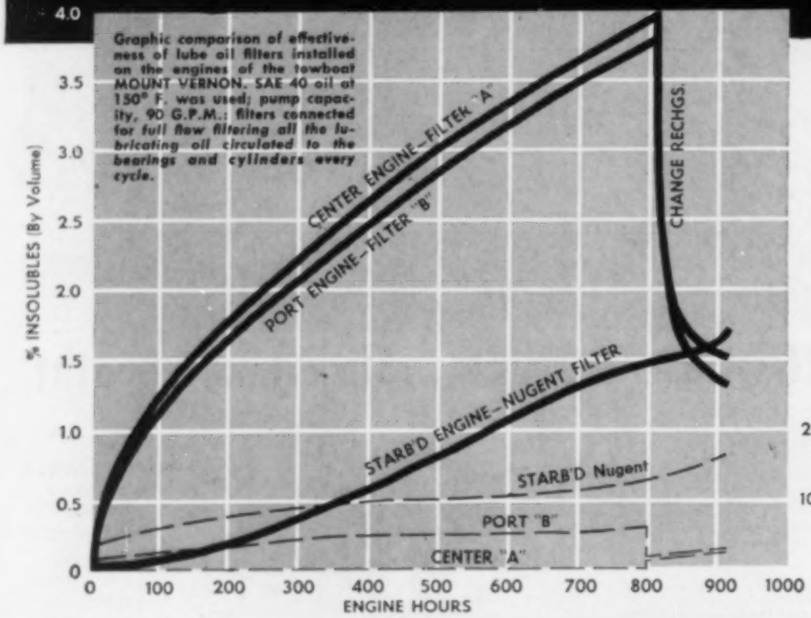

Dual springs, long guides. Pressure-oiled rockers. Stellite-faced valves and seats.
American Bosch single-hole pintle nozzles.
Clean-burning combustion chamber removes from outside. Upper half water cooled; lower half air insulated to concentrate heat at throat.
Four non-stick "keystone" rings, top ring chrome-plated. Two flat oil rings.
Built-in oil cooler increases oil and engine life.
Full length water jackets.
Hardened renewable cylinder sleeves test 375-425 Brinell.
Rifle-drilled rods. Oil jets cool pistons.
American Bosch fuel injection pump.
High-capacity outside oil pump.
Hardened camshaft, single forging.
Hardened main and rod journals. Steel-back, triple-element precision bearings, pressure oiled.
Drop-forged hardened crankshaft. High-speed counterweights not shown.
Alloy-steel heat-treated rod and main bearing bolts.

Model 6-WAKD
Super-Duty
DIESEL
Six cylinders
6¼-in. bore
6½-in. stroke
1197 cu. in.
peak hp 224
@ 1600 rpm.
Send for
Bulletin 1415

179

WAUKESHA MOTOR COMPANY, WAUKESHA, WIS., NEW YORK, TULSA, LOS ANGELES

Side-by-side Comparison
under operating conditions
proves the superiority
of NUGENT Filters

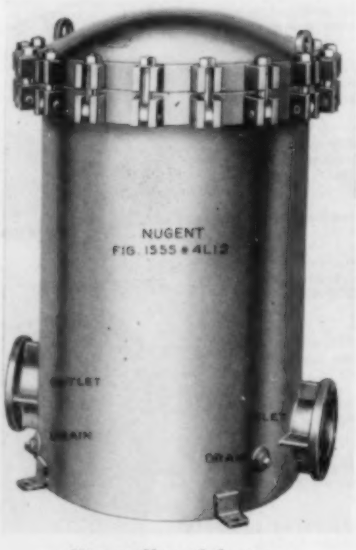


Graphic comparison of effectiveness of lube oil filters installed on the engines of the towboat MOUNT VERNON. SAE 40 oil at 150° F. was used; pump capacity, 90 G.P.M.: filters connected *for full flow filtering all the lubricating oil circulated to the bearings and cylinders every cycle.*

IN order to unquestionably determine the relative effectiveness of three leading lube oil filters, the owners of the towboat, MOUNT VERNON, installed a different make of filter on each of the boat's three identical engines. At regular intervals for 800 engine hours, the cleanliness of the oil was checked and recorded. The graph above shows the results—at the end of 800 hours the oil that was Nugent filtered contained less than half the concentration of insolubles as the more effective of the other two filters. Note, too, that oil passing through the other two filters was dirtier in 200 hours than the Nugent filtered oil was at the end of 800 hours.

Nugent filtering will give you this effectiveness, too. It will add to the life of your engines by reducing the amount of harmful impurities that reach vital working parts. It will extend the life of lube oil by keeping it cleaner longer.

For full information on how Nugent filtering can help you, write, outlining your filtering problem. Descriptive literature on Nugent filters is also available on request.



Nugent filter of the type used in the test aboard the MOUNT VERNON.

NUGENT TRADE MARK

Wm. W. Nugent & Co., Inc.
422 N. Hermitage Ave. CHICAGO 22, ILLINOIS

OIL FILTERS, OILING AND FILTERING SYSTEMS, TELESCOPIC OILERS, OILING DEVICES, SIGHT FEED VALVES, FLOW INDICATORS
Representatives in Boston • Cincinnati • Detroit • Houston • La Junta, Colo. • Los Angeles • Minneapolis • New Orleans • New York • Philadelphia • Portland, Ore. • San Francisco • Seattle • St. Louis • Tulsa • *Representatives in Canada:* Montreal • Toronto • Vancouver

Established 1897

than the existing British and German machines. 'Mechanical' stowers, using high-speed belts or rotating paddles to throw out the rubbish, have also been tried out, but those so far designed can cause sparks and so are limited to nongassy workings."

From the annual report of the British National Coal Board.

Air Starter for Jets

"Compressed air is going to take on a new job — reducing starting time for jet engines. It may open up a whole string of new uses for pneumatic gadgets.

"The pneumatic-starter idea is a follow-up on a technique used in Korea. The combat boys have been backing a live jet up to the nose of a cold one. The hot blast gets the turbine spinning, which means that you don't start generating heat or burning fuel until the turbine is moving at a pretty good speed.

"An Air Force contract to develop a pneumatic starter for turbojet and turboprop engines has been awarded to Jack and Heintz, Inc., of Cleveland. The firm now makes a variety of electric starters for aircraft and tank engines.

"Actually, the pneumatic starter has two advantages, economical and tactical. The biggest plus is that it cuts warm-up time. It takes electric starters a minute to a minute and a half to turn over a jet engine. J&H engineers believe they can pare starting time to less than 30 seconds using a compressed-air device.

"Jet engines have a voracious appetite. Fuelwise, every minute of warm-up on the ground is said to mean about 90 miles in the air. A jet's combustion chamber is also about the hottest place this side of Satan's furnace — especially during warm-up. With a false start, there is less time for the intense heat to wear down turbine blades and other inner workings. Once the plane is moving, incoming air cools the exhaust to a respectable 1000°F.

"The big tactical advantage comes in getting planes off the ground faster after the 'scramble' signal is flashed."

Business Week, May 31, 1952

Radio on Pipe Lines

"The pipe-line industry is taking to microwave (radio) on a wide front. Directionally beamed microwave relay stations paralleling a pipe line provide not only voice communication but multiple circuits for metering, remote control of valves, pumps and compressors, facsimile and teleprinter operations. The possibility of interference with outside radio services is minimized through properly designed directional antennas . . . . Altogether, the petroleum industry operates 75 percent of all microwave installations to date."

George Weber in Oil & Gas Journal, June 23, 1952

Books and Industrial Literature

Need of a sound national mineral policy and some of the considerations basic to the establishment of such a policy for the nations of the world are stressed by Edward Steidle, dean of the School of Mineral Industries, The Pennsylvania State College, in his book *Mineral Forecast 2000 A. D.* Dean Steidle reviews the United States' dependence on outside sources for many strategic and critical minerals during World War II and presents information, as accurate as can be determined at present, on reserves and on the availability of mineral fuels.

The 216-page book is divided into two parts. The first section covers such topics as the relationship of the mineral industries to the future of the United States, conservation of irreplaceable mineral resources by intelligent use, the deficiencies in the nation's program for stockpiling strategic and critical materials, the industries' manpower shortage and the Point 4 Program. The present and future status of the important mineral fuels and of the metallic and nonmetallic minerals are primarily dealt with in the second section.

Despite our decreasing supplies of coal and petroleum—our major sources of energy—and contrary to popular belief, Dean Steidle does not consider atomic energy to be a "cure-all" but believes that solar energy will be harnessed and used extensively in years to come. Geology, meteorology, geography, mineral economics, extraction and preparation, safety and health, water supplies, and education, as they apply to the mineral industries, are also discussed, as well as problems to be overcome within the next 50 years. Published by The Pennsylvania State College, copies of the book can be obtained from the Mineral Industries Extension Services, The Pennsylvania State College, State College, Pa. Price $3.00.

Plant and combustion engineers interested in recording stack smoke density and combustion performance may obtain literature on the subject from the Ess Instrument Company, Bergenfield, N. J. Write for Bulletin 512, which is a concise 2-page descriptive sheet on the Ess smoke recorder.

A booklet commemorating the fiftieth anniversary of the Pressed Steel Tank Company briefly describes the progress made since 1902 by diverse American industries through the aid of its metal containers and deep-drawn component parts. Entitled *Design for Progress*, the publication may be obtained from the concern at 1445 S. 66th Street, Milwaukee 14, Wis.

A new reversible and replaceable Blaw-Knox cutter for clamshell buckets is fully described in Bulletin 2399 being distributed by the company's Bucket Department, Farmers Bank Building, Pittsburgh 22, Pa. The new tooth consists of a base which is permanently attached to the scoop or lip and of a renewable tip which fits into a slot and wedges itself into the base. Bases and cutters are available from stock for many Blaw-Knox buckets now in use.

A 12-page illustrated manual on manometers of interest to engineers and operators of industrial plants is being distributed by King Engineering Corporation, Box 510, Ann Arbor, Mich. It includes basic facts and definitions on pressure measurement; explains how different types of manometers operate and what they measure; and contains detailed information on installation, operation and maintenance. English and

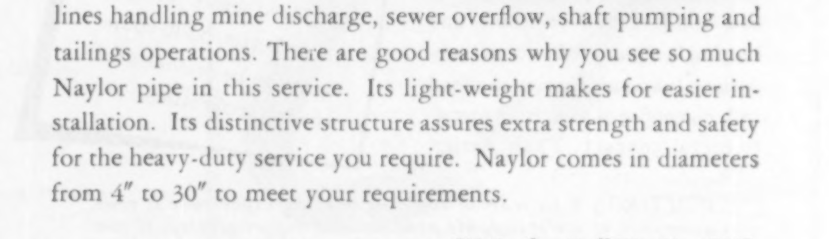
Familiar Scenes

IN MINING SERVICE

Water Lines by NAYLOR

Typical of the uses of Naylor pipe in water service are these lines handling mine discharge, sewer overflow, shaft pumping and tailings operations. There are good reasons why you see so much Naylor pipe in this service. Its light-weight makes for easier installation. Its distinctive structure assures extra strength and safety for the heavy-duty service you require. Naylor comes in diameters from 4″ to 30″ to meet your requirements.

Write for Bulletin No. 507.



Naylor Pipe Company
1245 E. 92nd St., Chicago 19, Ill.
New York Office:
350 Madison Ave., New York 17, N.Y.

GET RID OF YOUR
"DOWN-TIME" WORRIES
with a dependable

WALDRON Improved Gear Type **COUPLING**

better built to eliminate sources of operating trouble

The steadily growing preference for these sturdy WALDRON couplings in all major industries is a tribute to the quality and workmanship that goes into them. Power is transmitted through solid forged steel hubs and one piece sleeves, for added assurance of safety at high speeds. All adverse and crank action on shaft and bearing is eliminated and an ever-present lubricant carries the load with no chance of wear from metal-to-metal contact. Their design permits use of smaller physical capacity for same size shaft. Longer trouble-free service makes these couplings the most economical to buy and use.

By slight revision of standard basic design, these better built couplings can be provided for special applications.

WALDRON'S 40 years of coupling making experience is your assurance of a dependable product and expert service. Write for Catalog 57-A to get full particulars and engineering data.

JOHN WALDRON CORP.
NEW BRUNSWICK NEW JERSEY

Sales Representatives in Principal Cities

metric tables of equivalents are given for manometer readings taken with various indicating liquids, together with temperature correction factors and instructions on how to use them.

A handy 28-page reference catalogue containing a cross section of its complete line of modern scales for every industrial need has been compiled by The Howe Scale Company, Rutland, Vt. Referred to as Condensed Scale Catalogue No. 11, it gives essential information and specifications on 1000 models designed for weighing from $\frac{1}{64}$ ounce to 400 tons. Copies will be sent free upon request.

A 6-page bulletin has been released by T. B. Wood's Sons Company on its Life-Lube pillow blocks featuring a new housing and permanent lubrication sealed in by synthetic rubber bonded to a steel core that also keeps out dirt and moisture. The publication includes a description of the firm's flange units and a load rating table. Write for a copy of Bulletin No. 194 to Chambersburg, Pa.

Catalogue 40, now being distributed by Fischer & Porter Company, 6390 County Line Road, Hatboro, Pa., discusses its variable-area flow meters provided with newly developed tapered metal metering tubes for service where it would be impractical or dangerous to use ordinary glass metering tubes. A section of the 12-page publication is devoted to meter extensions and extension combinations.

Star Stainless Screw Company, 190 Union Avenue, Paterson 2, N. J., has issued a 20-page illustrated catalogue which lists its complete line of stainless-steel fastenings and gives specifications for each in easily read chart form as an aid to selecting and ordering. Serveral pages are devoted to decimal equivalents of pertinent fractions and to the structural quality of stainless steels. Ask for Catalogue No. 52-A when writing for a copy.

Ferrous castings and their applications in abrasion-resistant fields are discussed in a 24-page booklet just released by American Brake Shoe Company, 230 Park Avenue, New York 17, N. Y. It suggests a system for analyzing service conditions and selecting the proper alloy to meet each condition. Tables, charts and illustrations help to bring out the important points dealt with. Ask for *Ferrous Castings for Abrasion Resistance* when writing for your copy.

Intercoolers for cooling compressed air between supercharger blowers and air manifolds leading to cylinders of diesel, natural-gas and other 4-cycle engines are described in Catalogue No. 1652 obtainable from Young Radiator Company, Racine, Wis. Cooling is done in a tube-and-fin cooler in which the hot air passes over the finned surfaces while the cooling fluid—either fresh or sea water—circulates through the tubes. The brochure covers the two types of supercharging systems, low- and high-pressure, now commonly used for the purpose.

A comprehensive bulletin on the subject of spray nozzles for metal cleaning, bonderizing, spray quenching, gas washing, and similar industrial applications has been prepared by Binks Manufacturing Company, 3122 Carroll Avenue, Chicago 12, Ill. Profusely illustrated, the 40-page publication contains a wealth of information on nozzle dimensions, capacities, spray angles, etc., and is indexed for easy reference. To obtain free copies of Bulletin No. 5200 requests must be written on company letterheads.

STOP
Excess Wear

...with COOK Graphitic Iron Compression Rings

There are many factors that influence ring and cylinder wear. But one thing is sure . . . when you install Cook "Job-Engineered" Rings, you may expect longer ring and cylinder life. Why? Because the rings will have been engineered to correct the causes of the trouble, and, equally important, they will be made of Cook Graphitic Iron . . . a superior wear-resisting material. Write today for complete information.

C. Lee Cook Mfg. Co., Incorporated, Louisville, Ky.
Branch Offices in Baltimore, Boston, Chicago,
Cleveland, Houston, Los Angeles, Mobile,
New Orleans, New York, San Francisco and Tulsa.

COOK 101—a standard service ring for compressor pistons—one of the many styles of Cook rings for compressor packings and pistons.

COOK
PISTON RINGS

. . . SEALING PRESSURES SINCE 1888 . . .

Let's Call Wire Rope Constructions *by their Right Names!*

This is a message of importance to every user and purchaser of wire rope. It is information that will help eliminate much of the past confusion over wire rope terminology.

How did this confusion arise? Let's illustrate briefly. For years 6 x 19 has been just a name for a variety of six-strand ropes, few of which actually have 19 wires per strand. As an example, our popular 6 x 19 W has always contained 25 wires per strand; the 6 x 19 U, 21 wires per strand. The 6 x 19 Seale, on the other hand, really does have 19 wires in each of its strands. Until recently, the letter or name following the numbers denoted the actual construction; but many users did not know this, and the omission of these symbols occasionally resulted in costly misapplications.

To clarify matters in the various classes of rope, Bethlehem has revised the entire list of misleading designations. For instance, in the Bethlehem terminology, Type W rope is now designated—accurately—as 6 x 25 W (not 6 x 19); Type Q is 6 x 41 Q (not 6 x 37). This completely accurate terminology applies to each and every rope that Bethlehem makes.

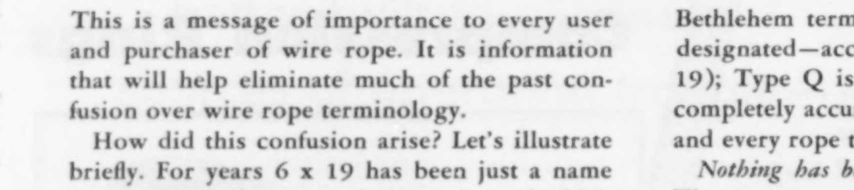
Nothing has been changed but the designation. The ropes are made to the same high standards of Bethlehem quality. *Constructions are the same as in the past.* Only the names, the designations, are different. The numbers now mean what they say.

We earnestly solicit your help in publicizing this information. The transition now under way is one that has long been needed.

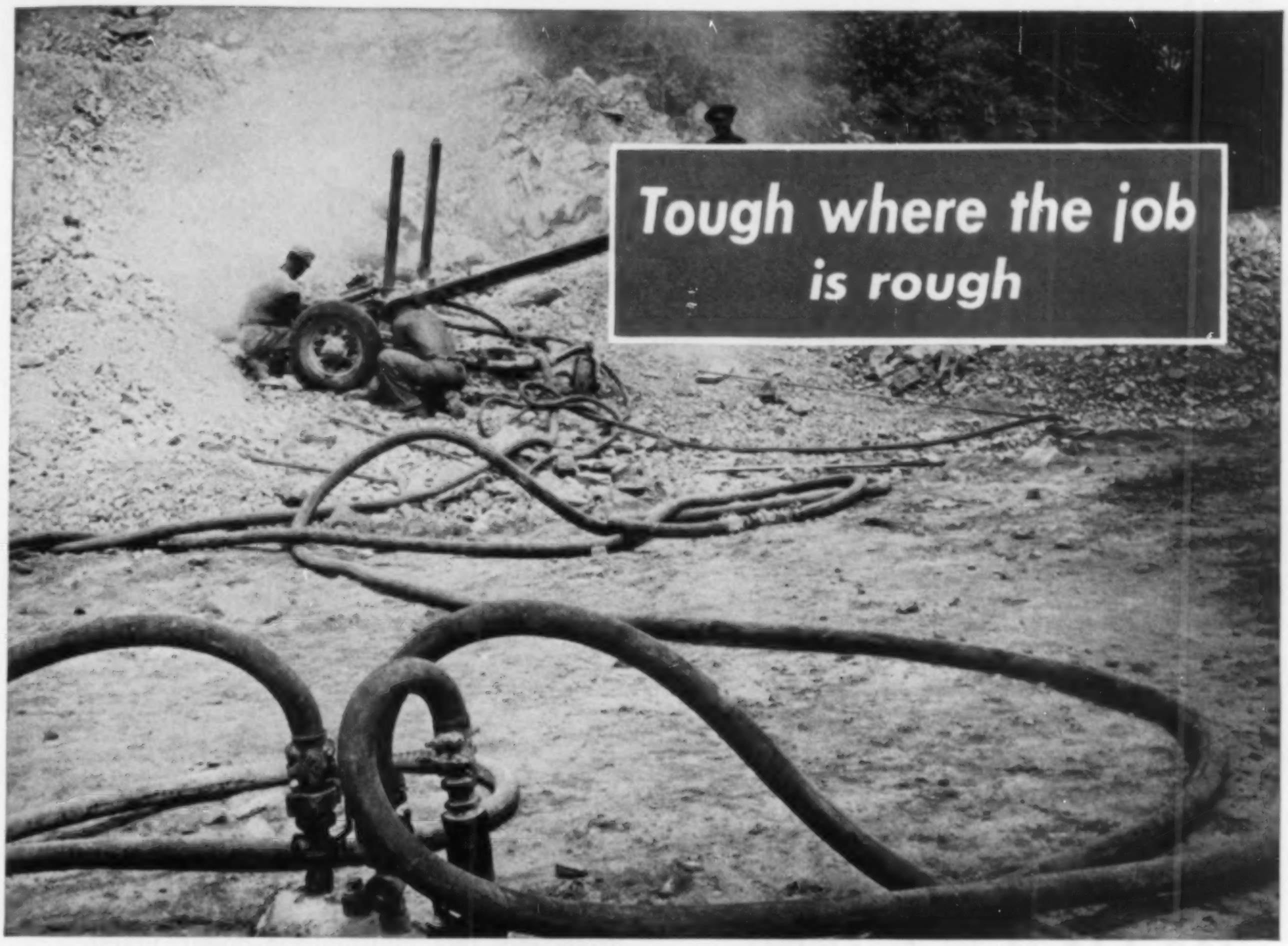
BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL



Of these three ropes, Seale is the only one with 19 wires a strand. Yet for years all three types have been known as 6 x 19. This is not an isolated case. Similar instances occur in other classifications of rope.



Air hose with cover and tube of NEOPRENE is built for lasting service in road construction

Breaking trail for a highway taxes the endurance of all types of construction equipment—especially air hose. Feeding the pneumatic drills wherever they go, the hose is dragged across razor-sharp rocks under a blistering sun. Hot oil in the line threatens the hose tube. Certainly no proving ground could be tougher. But here's an air hose that comes back for more! It's made inside and out with Du Pont neoprene.

The cover of neoprene is tough and durable . . . resists abrasion, cutting and chipping throughout its long life. And, because neoprene can withstand the deteriorating effects of sunlight, heat and weathering, the fabric reinforcement receives maximum protection.

The neoprene tube won't go to pieces when exposed to hot lubricating oil in the air stream. No crumbled particles are carried along to clog vital tool parts. And neoprene's toughness and flexibility assure long, trouble-free service under the most adverse conditions.

Du Pont supplies neoprene to air hose manufacturers who use it in their top-quality lines. Ask your supplier about hose with cover and tube of neoprene. He'll be glad to show you how it's built for rugged service.

neoprene notebook
LOW TEMPERATURE TESTING OF ELASTOMERS . . . PART 1

FREE! The Neoprene Notebook. Each issue points out new, unusual applications of neoprene . . . new products . . . interesting stories. Write today to get on the mailing list. E. I. du Pont de Nemours & Co. (Inc.), Rubber Chemicals Div. Y-8, Wilmington 98, Delaware.

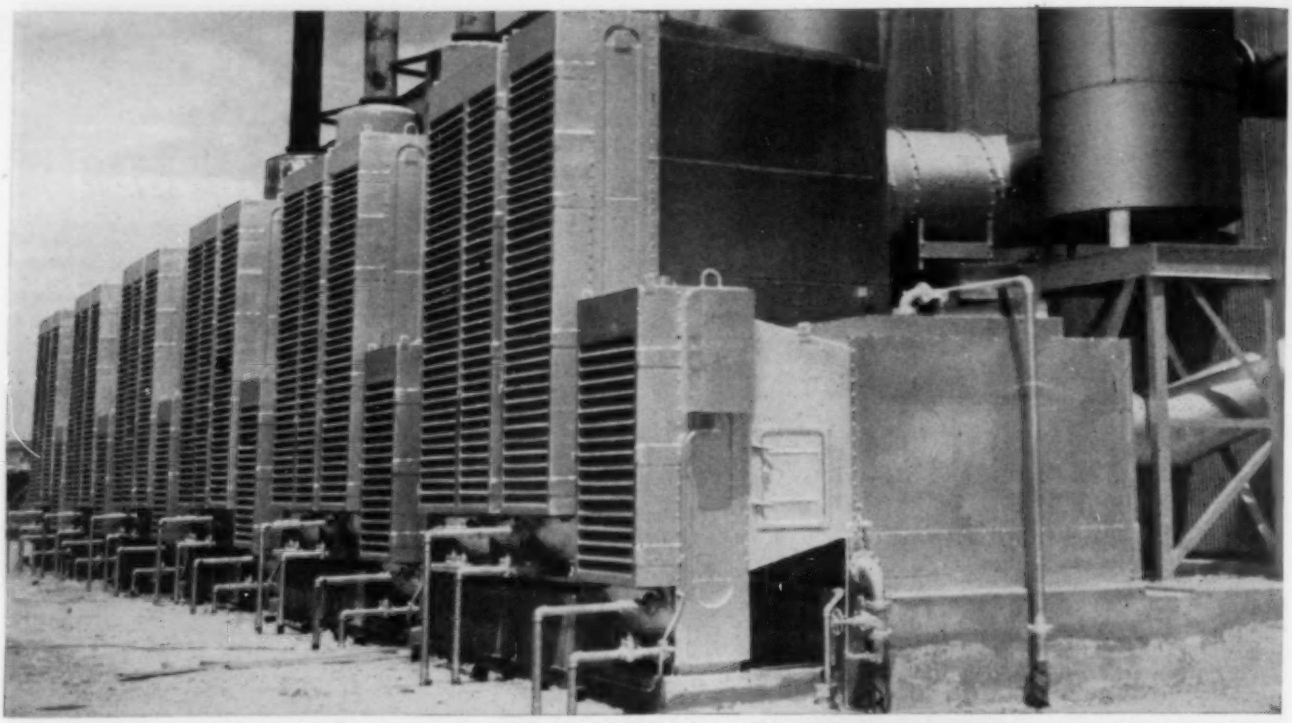
NEOPRENE

The rubber made by Du Pont since 1932

DU PONT
REG. U.S. PAT. OFF.

150th Anniversary

BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY



One section of the 130 Multi-Duty Filters which serve 83 engines and power house ventilation system.

Filtering 5,500,000 cfm!

130 AAF Multi-Duty Filters Serve Engine Room of New Reynolds San Patricio Plant

Imagine a power plant capable of supplying electricity for the combined residences of Ft. Worth, Dallas, Houston and San Antonio! That's the generating capacity of the 83 engines serving Reynolds Metals new aluminum reduction plant at San Patricio, Texas.

This "powerhouse" is made up of 42 Cooper-Bessemer, 3700 hp., 4-cycle, supercharged engines and 41 General Motors, 2850 hp., 2-cycle radial gas engines. Their air intake requirements plus that of the engine room ventilating system total 5,500,000 cfm.

Protecting this multimillion-dollar investment against the ravages of dust and dirt are 130 AAF Multi-Duty Type CMS Filters. These filters, designed for heavy dust loads, clean both the air and themselves *automatically*. It is this continuous, self-cleaning action that assures uniform air delivery and constant high air-cleaning efficiency. And in this installation the Viscosine filter oil is continuously circulated and cleaned to further simplify maintenance.

This installation solves Reynolds air-cleaning problems. Yours may be different. AAF has both engineering experience and a line of filters which, when combined, result in the solution—not just a sale. We'll welcome the opportunity to work with you in cutting costs with clean air.

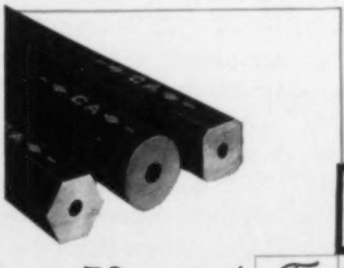
Today's Best Buy is Better Air!

AAF

American Air Filter

COMPANY, INC.

402 Central Avenue, Louisville 8, Kentucky • American Air Filter of Canada, Ltd., Montreal, P.Q.



teamwork
in
specialties

THE BLASTER

CRUCIBLE HOLLOW
DRILL RODS

In rock-drilling operations, the blaster is a key man. He plans the blast, tells the drill-runners where to drill their holes, loads the charge for the greatest effectiveness.

He expects . . . and gets . . . peak efficiency from his men and the tools they use.

This is why Crucible Hollow Drill Rods rank first with crews supervised by top-notch blasters. Experience has shown them that Crucible rods stand the rapid-fire battering of modern rock-drilling longer; give them the least breakage, the greatest service life.

Crucible Hollow Drill Rods are right for the job because they are made by the world's largest producer of *tool and high speed steels.* From this metallurgical experience come the high mechanical properties that have set record after record for least cost per foot drilled. Use Crucible Hollow Drill Rods in all your drilling operations.

CRUCIBLE first name in special purpose steels

52 *years of* *Fine* *steelmaking*

HOLLOW DRILL RODS

CRUCIBLE STEEL COMPANY OF AMERICA, GENERAL SALES OFFICES, OLIVER BUILDING, PITTSBURGH, PA.

REX HIGH SPEED • TOOL • REZISTAL STAINLESS • ALLOY • MACHINERY • SPECIAL PURPOSE STEELS

HESS-BRIGHT
NEW
NEW
NEW
Hess-Bright Pillow Blocks

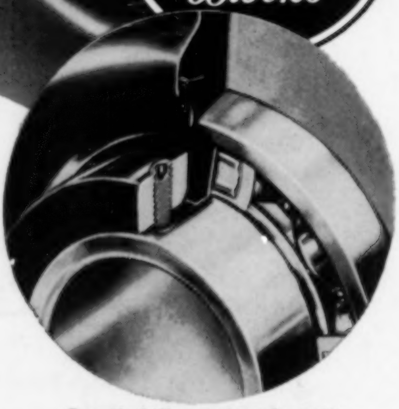
NEW from SKF

the HESS-BRIGHT "SY" UNIT PILLOW BLOCK

A new Unit Pillow Block, designed by SKF to meet tomorrow's needs of modern industry.

Here are the design features:

- SKF Red Seal, made of DuPont Fairprene, retains lubricant. Wiping action of the seal against the inner ring is practically frictionless.
- Rotating flingers exclude dirt.
- Set screws for ease of installation.
- Spherical outer ring compensates for initial misalignment.
- Alemite fitting for re-lubrication.
- Interchangeability with existing installations made possible by bolt hole spacing and center height features.
- Shaft diameters $1\frac{3}{16}''$ to $2\frac{15}{16}''$.



Detailed illustration of rotating flinger and RED SEAL—the extremely light tension contact seal.

SKF®

BALL AND ROLLER BEARINGS

IN EVERY INDUSTRY, SKF Puts The Right Bearing In The Right Place

From now on, the name to remember in Unit Pillow Blocks is HESS-BRIGHT "SY"—manufactured in our plants, to the same high quality standards as all SKF products. Ask your SKF Distributor to show you the HESS-BRIGHT "SY"; or write SKF direct for complete information on this *newest* Unit Pillow Block.

SKF INDUSTRIES, INC., Phila. 32, Pa.—*manufacturers of* **SKF** *and* HESS-BRIGHT *bearings.* 7323-A

No Leakage
No Lubrication

That's why Ingersoll-Rand's advanced design
DMV and DHV PUMPS
can end your maintenance problems in general hydraulic service

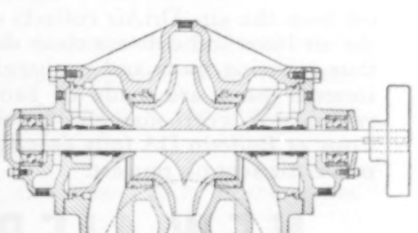
SINGLE-STAGE
DOUBLE-SUCTION
HEADS TO 340 FT.
CAPACITIES TO 2100 GPM
TEMPERATURES TO 200° F.

Ingersoll-Rand

✓ Double Mechanical Shaft Seals
✓ Permanently Lubricated Ball Bearings

- **Extra Protection Against Shaft Leakage** through use of efficient *double* shaft seals in place of usual, packed stuffing boxes.
- **Double Shaft Seals** end stuffing box maintenance.
- **Longer Seal Life** assured with *double* shaft seals. Clean sealing water is injected to protect sealing surfaces when pumping gritty liquids.
- **Sealed, Cartridge-Type Bearings** require no lubrication throughout their service life.

These advanced design features make the DMV line the simplest and most maintenance-free single-stage double-suction pumps ever developed by Ingersoll-Rand for general hydraulic service. Ask your nearest I-R representative for complete information on this latest pumping development.

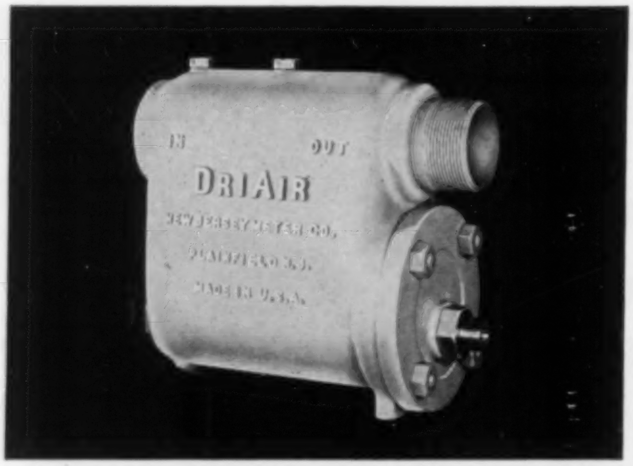


772-10

Ingersoll-Rand
Cameron Pump Division
11 Broadway, New York 4, N. Y.

COMPRESSORS • PUMPS • AIR AND ELECTRICAL TOOLS • VACUUM EQUIPMENT • ROCK DRILLS • CONDENSERS • GAS AND DIESEL ENGINES

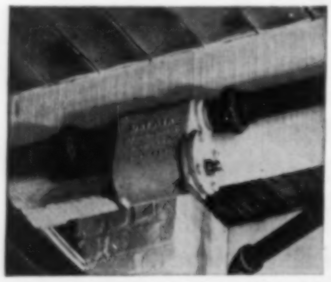
DEPENDABLE PNEUMATIC SERVICE



WHEN EQUIPMENT IS PROTECTED BY

DRIAIR

A COMPLETE SELF-CONTAINED UNIT



DriAir may be installed by suspending it from the piping, without any other support, or may stand on the floor near equipment being protected.

DRIAIR speeds production by separating and automatically ejecting the condensed water and oil from the air. DriAir collects dirt and rust from the air lines and delivers clean dry air to the tools, thus reducing wear and prolonging their life. All internal parts are made of bronze or copper—resistant to corrosion and practically permanent. Copy of Bulletin DA fully describing the operation of DriAir sent on request.

NEW JERSEY METER COMPANY

PLAINFIELD, NEW JERSEY

REDUCE BULK STORAGE LABOR AND EXPENSE...

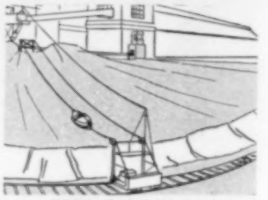
SAUERMAN POWER SCRAPERS

Stockpiling raw or processed materials, crushed ores, stone, clay, chemicals, salt, sugar, fertilizers, coal, etc.—indoors or outside—it's all the same to the versatile Sauerman Power Drag Scraper. And just one easily-trained man can do your particular job quickly, efficiently—at considerable savings to you!

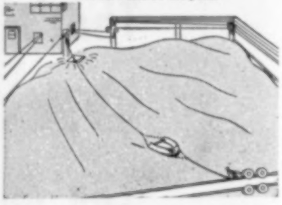
Sauerman Scraper equipment is mechanically simple, seldom needs repairs, is reasonable in cost. With a single machine you cover a large space, storing and reclaiming at the push of a lever.

Write for free, illustrated catalog on bulk handling methods.

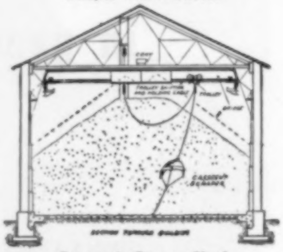
SAUERMAN BROS. Inc.
548 S. Clinton St.
Chicago 7, Ill.



700-ft. Radial Layout

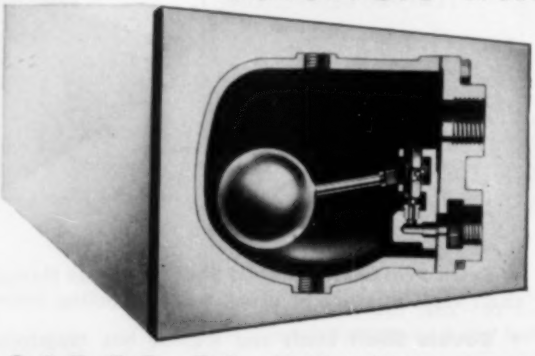


Scraper with Monorail

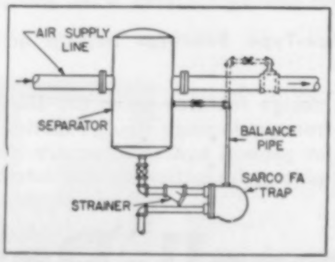


Scraper in Storage Shed

Drain compressed air receivers with



SARCO FA DRAIN TRAPS



Type FA Trap draining separator.

. . . also your intercoolers, aftercoolers and separators. These traps automatically release condensate as it forms . . . without the waste of air that occurs when blowdown valves are used. New technical bulletin No. 5-CA offers many suggestions as to how you can increase the EFFECTIVE capacities of your air compressors. Write today for your free copy. No obligation . . . of course.

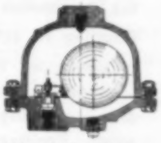
513

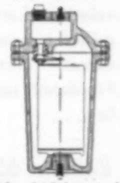
SARCO COMPANY, INC.
Represented in Principal Cities
Empire State Building, New York 1, N. Y.
SARCO CANADA, LTD., TORONTO 5, ONTARIO

No Moisture Removal System is Complete . . .

without Economical Armstrong Air Traps

No. 71 Snap Action Trap $30.00


No. 21 Ball Float Trap $11.00


No. 213 Inverted Bucket Trap $20.75

KEEP your expensive moisture removal equipment at top efficiency — automatically drain these vital units of the moisture they collect with low cost Armstrong Air Traps. Armstrong traps on separators, aftercoolers, etc., save you air, time and labor, eliminate human failure.

Ruggedly built, these units are available in three types, ball float, snap action or inverted bucket models to give you best service for a given condition.

Bulletin No. 1433 gives the details.

Local stocks mean quick delivery. Act today.

ARMSTRONG MACHINE WORKS
885 Maple St. • Three Rivers, Michigan

ARMSTRONG *Air* TRAPS

BUY ALL THREE FOR ONLY $6.00

or

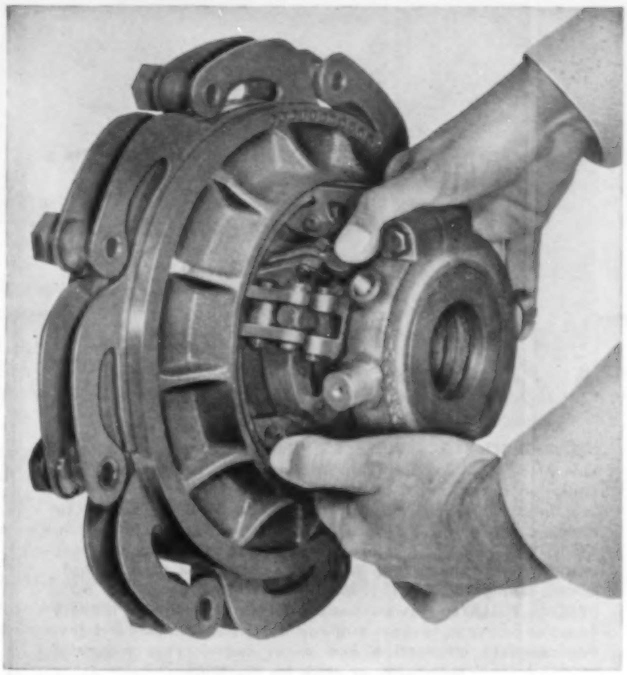
Any Combination at Proportionate Savings

Price Individual Books	Per Copy
Compressed Air Data	$3.00
Cameron Hydraulic Data	3.00
Cameron Pump Operators' Data	2.00

COMPRESSED AIR MAGAZINE, 942 Morris Street, Phillipsburg, New Jersey.
Please send me:

☐ Compressed Air Data, Cameron Hydraulic Data and Cameron Pump Operators' Data.................................All three for $6.00
☐ Compressed Air Data and Cameron Hydraulic Data..Both books for $5.00
☐ Cameron Hydraulic Data and Cameron Pump Operators' Data Both books for $4.50.
☐ Compressed Air Data and Cameron Pump Operators' Data Both books for $4.50.
☐ Enclosed is (money order) (check) for $........) ☐ Send books C.O.D. I understand that the books will be sent me postpaid, and that they may be returned within 10 days if not satisfactory.

Name ....
Company ....
Street No. ....
City .... State .... County ....



Over-center Double Flex-Disc, showing method of adjusting for wear by releasing thumb latch and turning toggle assembly.

The Over-Center *Flex-Disc A Quality Industrial Clutch

Low power losses, low maintenance costs, and a long, dependable service life characterize our Over-center *Flex-Disc* and Solid Disc friction clutches. These heavy duty, general purpose industrial clutches range in size from 275 to 19060 lbs.-ft. torque.

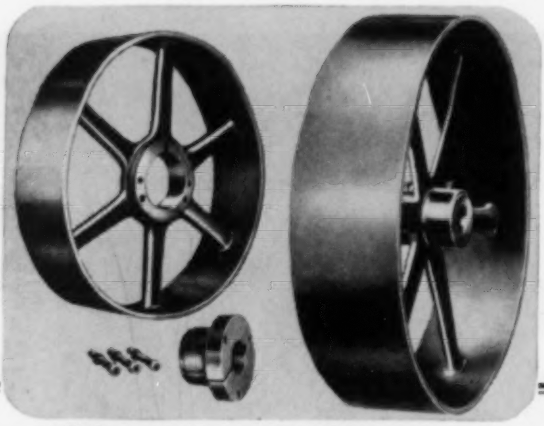
The history of the *Flex-Disc* type of clutch goes back twelve years, during which time it has been used by Ingersoll-Rand in their portable line of air compressors.

A corresponding Solid Disc Clutch with bolted up disc in two halves for easy removal is also available.

Our twenty years of engineering experience in clutch design is at your disposal. Write for bulletin 5003 for further information and specifications on Over-center clutches.

*U. S. Patent Nos. 2,177,362; 2,259,461; 2,303,201 and others pending.

INDUSTRIAL CLUTCH CORP.
Waukesha Wisconsin



A **Wood's** PULLEY FOR *EVERY* NEED

"SURE-GRIP" STOCK PULLEYS. With straight or crown face. One-piece flanged and split tapered hub permits easy installation and removal from the shaft. Available for immediate delivery in 2½" to 12" face widths and 4" to 36" in diameter.
STANDARD PULLEYS. Solid or split through rim and hub with straight or crowned face. Accurately bored and carefully balanced. Diameters 2" to 120"—face width from 2" to 60".
SPECIAL PULLEYS. Flexible pattern set-up and modern foundry facilities permit us to make made-to-order pulleys without delay.
For complete information and prices consult your Industrial Distributor or write for literature

T. B. Wood's SONS COMPANY
CHAMBERSBURG, PA.
Mechanical Power Transmission Manufacturers—Since 1857.

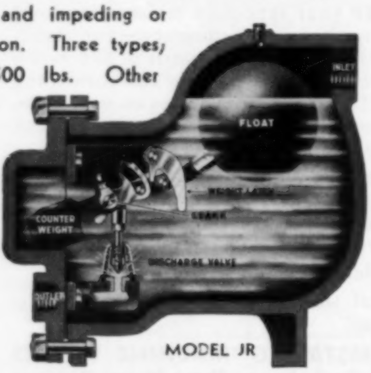
CAMBRIDGE, MASS. • NEWARK, N. J. • DALLAS, TEXAS • CLEVELAND, O.

New NICHOLSON
NON-PLUG AIR TRAPS

↗ *Introduce Oil-Eliminating Feature Preventing Build-up of Scum and Sludge*

In these Nicholson air traps you enjoy the advantages of the positive intermittent action of a float-operated air trap without the common problem of oil congealing on the mechanism and impeding or stopping its action. Three types; pressures to 1500 lbs. Other features: No air-wasting vent. Positive water seal at valve. Large orifice keeps valve clean. For details send for . . .

Bulletin 651



180 OREGON ST., WILKES-BARRE, PA.

W. H. NICHOLSON & CO.
TRAPS · VALVES · FLOATS

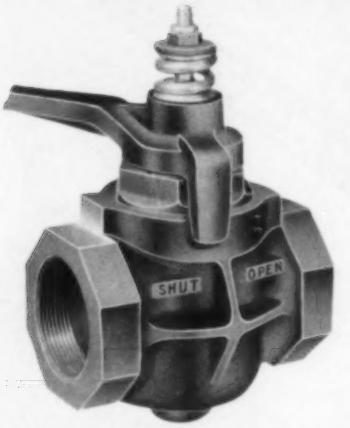
STEEL FORGINGS

NATIONAL FORGE & ORDNANCE COMPANY
Irvine, Warren Co., Penna.
STEEL MAKERS • FORGESMITHS • HEAT TREATERS • MACHINISTS • MACHINERY AND TESTING EQUIPMENT MFRS.

A GREAT NEW PLUG VALVE FOR COMPRESSED AIR LINES THAT WILL....

$TOP

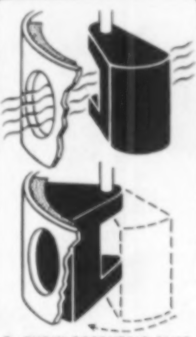
COSTLY VALVE LEAKAGE



COMPRESSED AIR LOSSES through faulty valving are expensive DOLLAR LOSSES.

STOP THEM with DeZurik EASY-OPERATING PLUG VALVES — The Only Valves Built with the AIR-TIGHT RUBBER-FACED PLUG!

DeZurik's Rubber-Faced Plug combines tough, resilient rubber with a rigid metal core. It closes DEAD-SHUT every time, regardless of line pressure or solid-matter intrusions. The plug and seat are eccentrically designed to completely eliminate friction, binding, scoring and lubrication. The plug seals the line with a cushioned, conforming closure, and the hardest, longest use can't stretch or distort it.

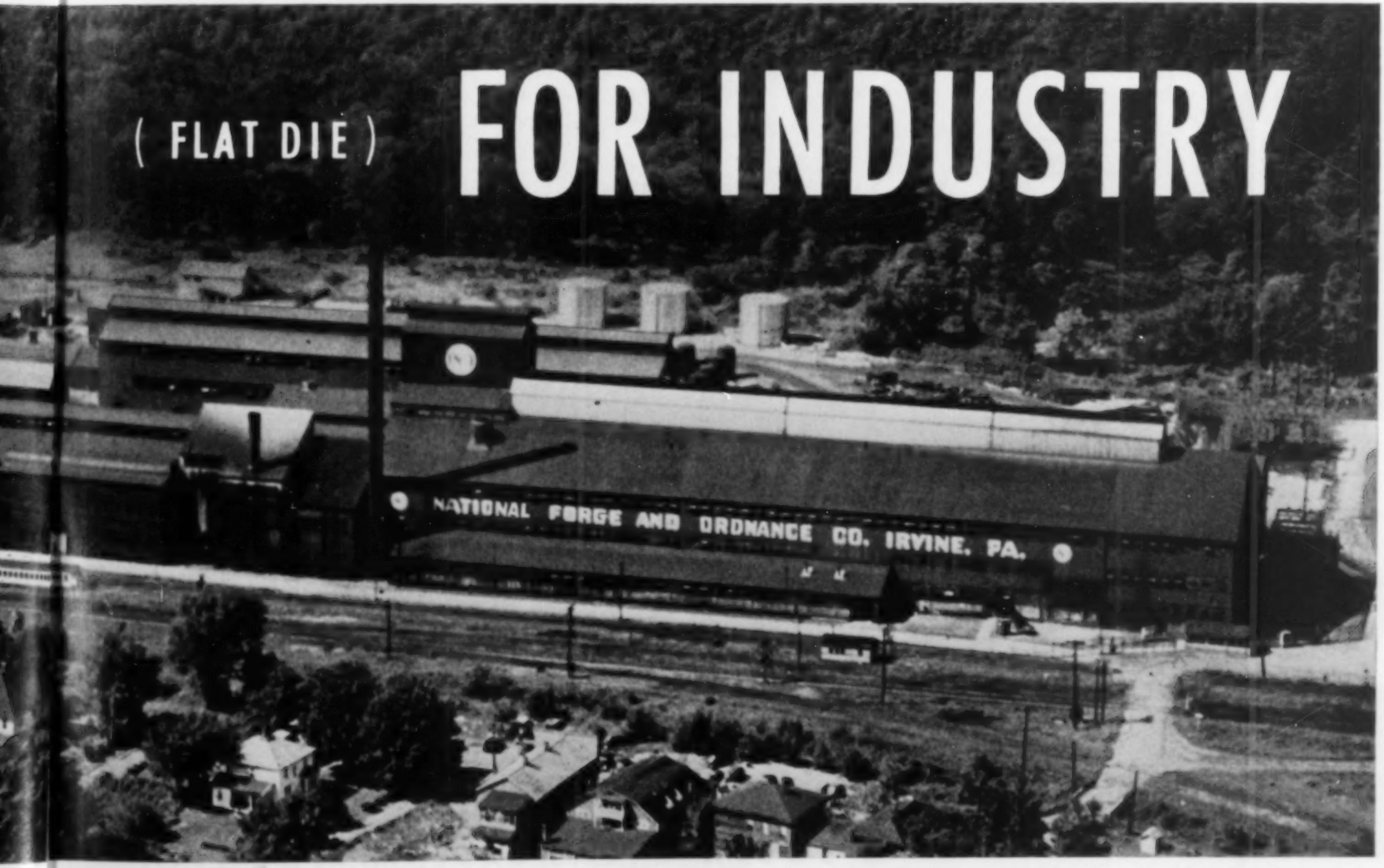


DeZURIK ECCENTRIC PLUG & ECCENTRIC SEAT CLOSE DEAD SHUT OR OPEN FULL WITH QUARTER TURN

Get the details on this air-saving, money-saving line of valves; write for complete bulletin.

DeZURIK SHOWER COMPANY

RIVERSIDE ROAD
SARTELL, MINN



DWEST RADIANT CORP

ALWAYS OUT FRONT WITH

Long·Life Service

The impressive service records of Bucyrus-Erie stripping shovels and draglines mean shift-after-shift, year-after-year performance in moving millions of yards of overburden at economical cost. These records amply prove the superiority of Bucyrus-Erie "years ahead" design and the top quality of Bucyrus-Erie craftsmanship — backed by the most extensive field experience of any excavator manufacturer. Bucyrus-Erie stripping shovels and draglines are available in capacities from 2½ to 36 cubic yards to fit any open-pit mine requirement.

135L51

BUCYRUS ERIE

SOUTH MILWAUKEE, WISCONSIN

Ahead of the Field

LOUIS ALLIS

DRIP-PROOF MOTORS

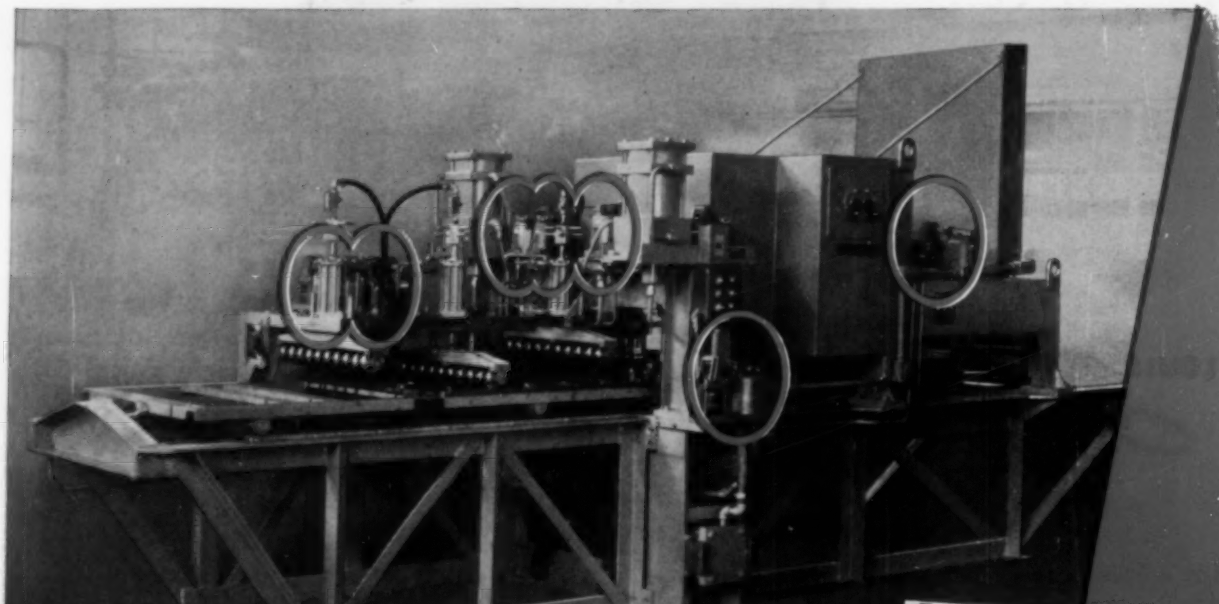
Louis Allis Drip-Proof motors combine with every detail of their pleasing appearance—Quality—Performance—and Stamina. They have the highest type of craftsmanship in their manufacture, ample factors of safety in their rugged design and long trouble-free operating life.

For over 50 years, The Louis Allis Co. has designed and manufactured electric motors to fulfill the changing requirements of an expanding American Industry. As a result, we can offer one of, if not the largest selection of types and sizes of special and standard motors available today. They are available in a complete line — from ½ HP to 1000 HP.

For quick, dependable service, contact your nearest Louis Allis Sales Engineer.

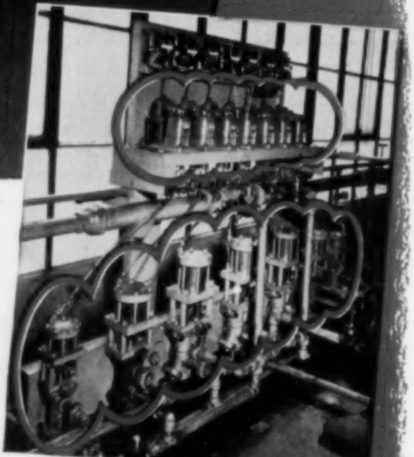
CHAMPIONSHIP PERFORMANCE

THE LOUIS ALLIS CO., Milwaukee 7, Wisconsin



Quick-As-Wink Air Valves on Multiple Welding Machine.

Quick-As-Wink Control Valves



Quick-As-Wink Valves for Hydraulic Testing Machine.

synchronize and coordinate related machine operations

Those successive and inter-related machine operations — that speed manufacture and cut costs — can only be as successful as the air and hydraulic control valves you use. Specify Quick-As-Wink Control Valves. Positive and fast acting, Quick-As-Wink Valves are designed and built to meet the most exacting requirements. Danger of "repeating", major cause of breakdowns and accidents, is practically eliminated. They will deliver dependable and precision performance month after month, and year after year. Foremen and superintendents know there's nothing better than Quick-As-Wink Control Valves. Can *you* afford to gamble with less?

Quick-As-Wink Valves Controlling Entry of Sheet into Terne Coating Line.

Quick-As-Wink
AIR AND HYDRAULIC
Control Valves

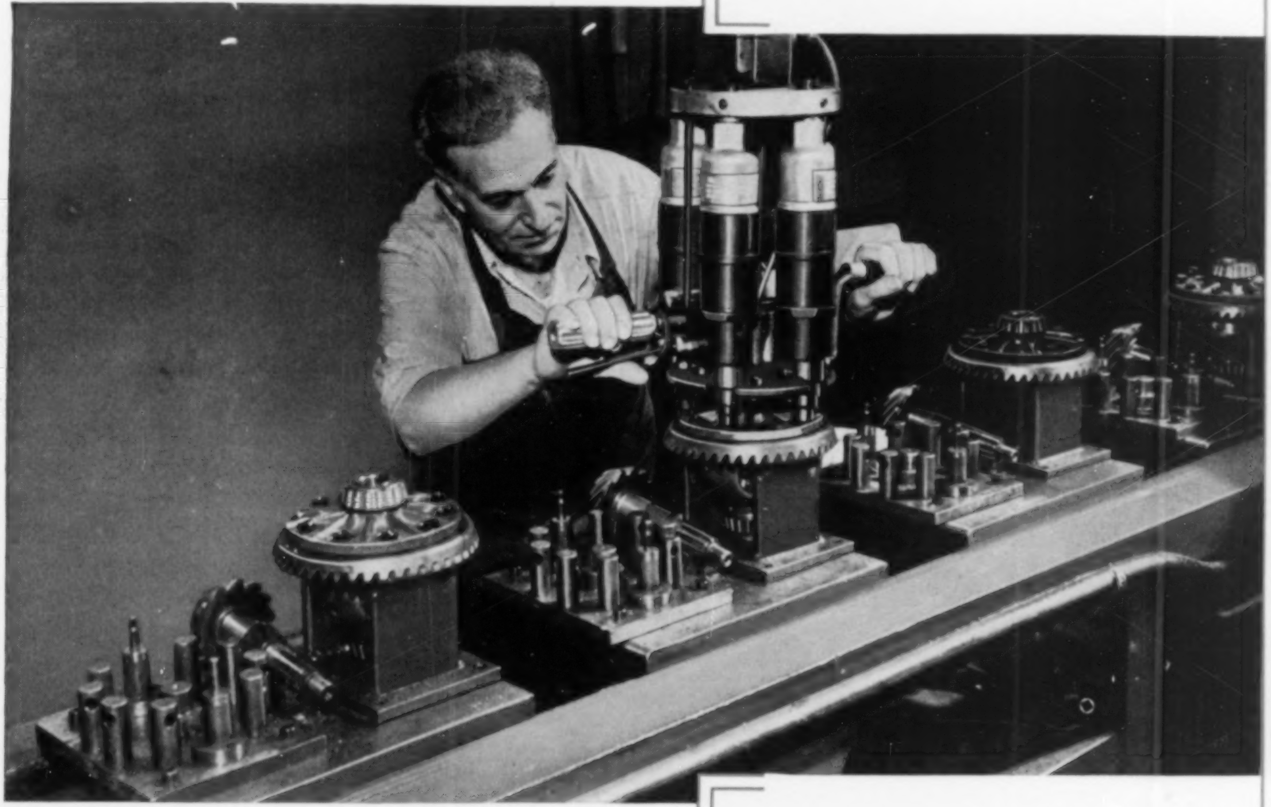
THE HIGHER THE PRESSURE • THE TIGHTER THE SEAL

Hand, Foot, Cam, Diaphragm and Solenoid Operated

Mfd. by C. B. HUNT & SON, INC., 1911 East Pershing St., Salem, Ohio

are you still running nuts one-at-a-time?

Ingersoll-Rand Multiple Nut Runners have increased output 70% over single power wrenches.*



For years multiple drilling, tapping and reaming have saved time and dollars. . . . Now you can tool for increased savings with Ingersoll-Rand *Multiple Nut Runners.*

IR MULTIPLE NUT RUNNERS GIVE YOU:

- 2 or more nuts driven at once . . . in the time formerly required to drive one.
- Good "quality control." . . . Torque is uniform on each and every nut.
- Safe Operation for operator. . . . Torque reaction is non-existent.
- Immediate on-the-job operation. . . . No special training needed for the operator.
- Low Maintenance. . . . Units in service show maintenance savings up to 50%.

All Ingersoll-Rand Multiple Nut Runners are built to your specifications. Our power-tool application engineers will gladly go over your nut running jobs with you and make their recommendations—there's no obligation on your part. Send for Bulletin 5099.

**Here's Nut Running History in the making!*

The times below from the records of a leading car manufacturer are based upon 1000 units of comparable nut running operations.

1912	Hand Wrench	200 Man Hrs.
1917	Speeder Wrench	100 Man Hrs.
1928	Single Power Wrench	50 Man Hrs.
1952	Multiple Nut Runner	14 Man Hrs.

IR

COMPRESSORS • AIR TOOLS • ROCK DRILLS
TURBO BLOWERS • CONDENSERS • CENTRIFUGAL PUMPS
DIESEL AND GAS ENGINES

Ingersoll-Rand
11 BROADWAY, NEW YORK 4, N. Y.

802-8

Keeps entire shop supplied with air, has TIMKEN® bearings to cut down wear

ALL the air that's needed by the Globe Machine and Foundry Company, Amarillo, Texas, is supplied by this one Ingersoll-Rand Type 40 compressor. It keeps air tools, air hoists and pneumatic molders working, besides providing air for cleaning.

To prevent breakdowns and minimize wear, Ingersoll-Rand mounts the crankshafts of its compressors on Timken® tapered roller bearings.

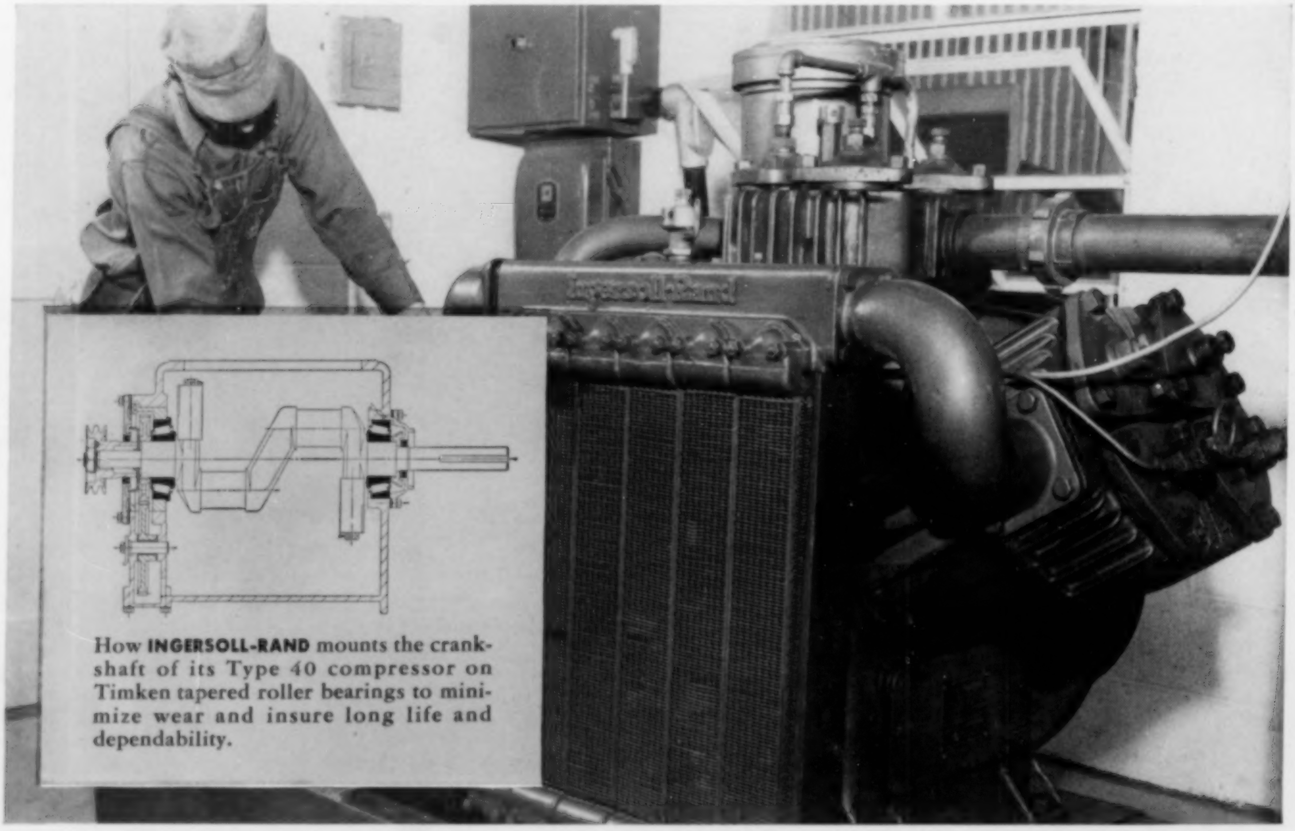
The tapered construction of Timken bearings permits them to take radial and thrust loads in any combination. They hold the compressor crankshaft in accurate alignment.

The true rolling motion of Timken bearings with the smooth finish of rollers and races virtually eliminate friction. Wear is negligible within the bearing itself. And because Timken bearings keep housings and shaft concentric, they make closures more effective. Lubricant stays in—dirt stays out. Compressor lubrication and maintenance costs are reduced.

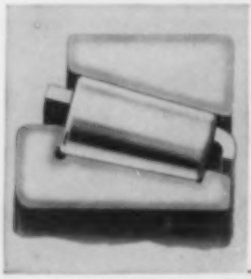
Line contact between rollers and races in Timken bearings provides load carrying capacity to spare. And since they're made of Timken fine alloy steel, Timken bearings normally last the life of the compressor.

No other bearing can give you all the advantages you get with Timken bearings. Make sure you have them in the machines you build or buy. Look for the trade-mark "Timken" on every bearing. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

TIMKEN BEARING EQUIPPED *This symbol on a product means its bearings are the best.*



How **INGERSOLL-RAND** mounts the crankshaft of its Type 40 compressor on Timken tapered roller bearings to minimize wear and insure long life and dependability.



GREATER LOAD AREA

Because the load is carried on the *line* of contact between rollers and races, Timken bearings carry greater loads, hold shafts in line, wear longer.

The Timken Roller Bearing Company is the acknowledged leader in: 1. advanced design; 2. precision manufacturing; 3. rigid quality control; 4. special analysis steels.

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS

NOT JUST A BALL ○ NOT JUST A ROLLER ⊂⊃ THE TIMKEN TAPERED ROLLER ⊂⊃ BEARING TAKES RADIAL AND THRUST LOADS OR ANY COMBINATION